

# Behaviour of post released translocated greater one-horned rhinoceros (*Rhinoceros unicornis*) at Manas National Park, Assam, India

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## Abstract

A post-release study of the behaviour of 10 greater one-horned rhinoceros' (*Rhinoceros unicornis*) translocated to Manas National Park, Assam, India was carried out to understand how each individual rhino behaves in a new environment. Distinct seasonal variation in activity was observed among the released rhinos. Maximum grazing activity was observed in the monsoon (June–September) and retreating monsoon (October–November) seasons while it was observed that the grazing rate decreased during the dry winter season (December–February). In the winter season, browsing activity was observed to increase. Resting activity was maximum during the winter and pre-monsoon (March–May) seasons. Walking activity of adult females and calves increased in the monsoon season, and was higher than that of adult males. It was observed that adult males wallowed more frequently during the monsoon season than adult females and calves. It was further observed that rhinos not only wallow for thermoregulatory purposes, but also readily eat aquatic plants. There was no drastic difference between behaviour patterns of translocated rhinos at Manas National Park and those of resident rhinos in Assam and Nepal. The rhinos' overall behaviour in the different seasons indicated that the translocated rhino population has adapted well at Manas National Park.

## Résumé

Une étude du comportement de 10 grands rhinocéros unicornes (*Rhinoceros unicornis*) transloqués au parc national de Manas dans l'Assam, en Inde, après leur libération a été réalisée pour comprendre comment chaque rhinocéros individuel se comporte dans un nouvel environnement. On a observé une variation saisonnière distincte de l'activité chez les rhinocéros libérés. On a observé une activité de pâturage maximale dans les saisons de la mousson (juin-septembre) et dans celle de la décroissance de la mousson (octobre-novembre) alors que l'on a observé que le taux de pâturage a diminué pendant la saison sèche d'hiver (décembre-février). En hiver, on a observé une augmentation de l'activité de brout. L'activité de repos a été maximale pendant les saisons d'hiver et de pré-mousson (mars-mai). L'activité de marche des femelles adultes et des bébés rhinocéros a augmenté pendant la saison de la mousson étant plus élevée que celle des mâles adultes. On a observé que les mâles adultes se vautraient plus fréquemment pendant la saison de la mousson que les femelles adultes ou les bébés rhinocéros. On a également observé que les rhinocéros se vautrent non seulement à des fins thermorégulatoires, mais aussi qu'ils consomment facilement des plantes aquatiques. Il n'y avait pas de différence drastique entre les comportements des rhinocéros transloqués au parc national de Manas et ceux des rhinocéros résidents dans l'Assam et au Népal. Le comportement général des rhinocéros dans les différentes saisons indique que la population des rhinocéros transloqués s'est bien adaptée au parc national Manas.

## Introduction

Translocation is the intentional release of an animal to the wild in an attempt to establish, re-establish or augment the population, either to introduce a non-native species or to restore a native species extirpated due to poaching or hunting (Griffith et al. 1989). It is a valuable tool for the recovery of species that have become either globally or locally extinct in their natural wild habitat (Sankar et al. 2010). Following release, it is imperative to observe animal behaviour in the new environment (IUCN 2012). Translocation is routine in some African range states and has played a vital role in increasing numbers of both white and black rhinos. There have been a few attempts of relocation of the greater one-horned rhinoceros (*Rhinoceros unicornis*; hereafter 'GoH') in Nepal and India, but there is much scope for research in this respect.

Newly-released rhinos (under wild-to-wild translocation programs) need extensive monitoring after release to determine the extent of their movement, and patterns of dispersal and habitat use (e.g. of water sources, and feeding patterns in different habitat types) at different times after release and in different seasons. To this end, the behaviour of translocated GoH in Manas National Park (MNP), India was systematically studied in order to gain a scientific understanding of their adaptation in the new habitat. The results, presented in this study, will aid future efforts of GoH translocation, as well as assist MNP authorities to prepare a rhino conservation strategy, in order to maintain a viable GoH population in the Park.

## Study area

Manas National Park is the core areas of the Manas Tiger Reserve and a UNESCO World Heritage Site. MNP is located in the foothills of the Himalayas in the northern Brahmaputra Valley and is situated between latitude 26°30' N and 27°00' N and longitude 91°51' E and 92°00' E (Figure 1; see colour plates: page i). The climate is tropical. The monsoon (June–September) is the hottest and wettest period of the year, while winter (December–February) is characterized by cool weather and fog. The pre-monsoon season (March–May) and the retreating monsoon (October–November) are transitional periods (Barthakur 1986). Averages monthly values for

temperature and rainfall range between  $27 \pm 6^\circ\text{C}$  and 2860 mm, respectively, during the monsoon and  $20 \pm 5^\circ\text{C}$  and 114 mm, respectively, during winter months.

The Park is situated in foothills gently sloping southward from 250 m down to 50 m above sea level. Almost half the Park consists of alluvial grasslands; the remainder is a mix of semi-evergreen and moist and dry deciduous forest. The northern belt contains extensive grassland areas and is flat and well drained. The area along the southern boundary receives water from streams that drain across the Park from north to south, and is often waterlogged during the monsoon rains. The Manas-Beki river system is one of largest northbank tributaries of river Brahmaputra, flowing through the Manas National Park by providing perennial water to the park and forming crucial habitat for freshwater fish, aquatic migratory birds and wild buffalos. MNP is famous for its rich floral and faunal biodiversity, including species such as tiger (*Panthera tigris tigris*), pygmy hog (*Sus salvanius*), golden langur (*Trachypitecus geei*), hispid hare (*Caprolagus hispidus*), Bengal florican (*Houbarogsis bangalensis*), and white-winged wood duck (*Cairina scutulata*).

Administratively, the MNP falls within the districts of Chirang and Baksa of Assam on the international boundary between India and Bhutan. It comprises three range areas, namely, from west to east: Panbari, Bansbari, and Bhuyanpara, each with its own range office where staff are based. The MNP is bounded to the north by Royal Manas National Park of Bhutan and to the east and west by buffer zones of the Manas Tiger Reserve. The southern boundary of the MNP is contiguous with densely populated agricultural areas and there are 61 villages located within 2 km of the southern boundary of the Park. Rice paddy cultivation is the principal economic activity.

Manas National Park has suitable rhino habitat and, prior to 1989, there was a population of over a hundred rhinos. The entire population of MNP was wiped out due to poaching in the early 1990s (Dutta et al. 2015). In 2005, the government of Assam, with support from the International Rhino Foundation (IRF), World Wide Fund for Nature (WWF) and the United States Fish and Wildlife Service (USFWS), launched the Indian Rhino Vision 2020 (IRV2020) to help in maintaining the existing rhino populations in Assam and to translocate rhinos into protected areas from which they had been exterminated in the recent past. The program aimed at achieving a population of 3,000 rhinos in Assam by the year 2020, in seven protected areas. Under IRV 2020, 18

rhinos were translocated from Kaziranga National Park (KNP) and Pobitora Wildlife Sanctuary (PWS) to MNP between April 2008 and March 2012 (Dutta et al. 2015).

## Materials and methods

In the translocation programme, a total 18 rhinos were released at MNP in between 2008 and 2012: 10 rhinos from PWS and eight from KNP (Table 1). As some of the rhinos chose to live in logistically difficult to access areas of park, only 10 rhinos could be monitored: three adult males (R1, R2 and R5), three adult females with calves (R3 with calf R4, R6 with calf R7, and R13 with calf R14) and one solitary female (R8) (See Photographs 1, 2, 3, 4, 7 and 8: colour plates: page ii).

Rhinos were radio collared with very high frequency (VHF) radio collars (African Wildlife Tracking) at capture sites (KNP and PWS). Tracking of the rhinos was carried out using directional antennae (Telonics RA-14K antennae, 148–152 MHz) and VHF radio receiver to record the data (Communication Specialists, R-1000 receiver, 148–152 MHz). A directional compass was used to triangulate rhino locations in dense and tall vegetation and Windows software LocateII and Locate III was used to obtain spatial information. Five pairs of camera traps were used

to observe rhinos in some of the more inaccessible areas. Rhinos were ear-notched as per IUCN-AsRSG methods at the capture site for better identification after the radio collar stopped functioning.

Immediately upon release, rhinos were located three times daily, in the morning (6–10 am), afternoon (10 am–2 pm) and evening (2–6 pm). Sometimes, they were also located at night (6 pm–6 am), depending on accessibility. During the monitoring process, patrolling elephants were used, as well as four-wheel jeep, motor bikes and bicycles; sometimes the researcher went on foot to track the rhinoceros and establish GPS coordinates (see colour plates: page ii, Photograph 9). The monitoring data were collected by the homing-in technique and, when the terrain was impassable, GPS coordinates and rhino locations were obtained by triangulation.

Focal behaviour sampling (Altman 1974) was conducted whenever a direct observation was possible. Following this method, which focuses on a particular behaviour rather than a particular animal, all occurrences of specified actions of one individual were recorded during a predetermined sample of one hour. Behavioural categories were broadly defined as: grazing, wallowing, walking, browsing, and resting (Table 2). Behavioural states were recorded if they lasted more than one minute (Kandel 2008). All data were recorded and analysed with support of MS Excel.

Table 1. Details of greater one-horned rhinos translocated to Manas National Park under the program Indian Rhino Vision 2020. PWS: Pobitora Wildlife Sanctuary; KNP: Kaziranga National Park

Batch no.	Translocated rhinos			Place of origin	Date of release
	No.	Description	Code nos.		
1	2	Two adult males	R1, R2	PWS	12 Apr 2008
2	2	Adult female with female calf	R3, R4	PWS	28 Dec 2010
3	4	Adult female with male calf One adult male One adult female	R6, R7 R5 R8	PWS	18 Jan 2011
4	2	Two adult females	R9, R10	PWS	9 Jan 2012
5	4	Adult female with female calf Adult female with male calf	R12, R11 R13, R14	KNP	20 Jan 2012
6	4	Adult females with male calf Adult female with male calf	R15, R16 R17, R18	KNP	12 Jan 2012

Table 2. Ethogram of rhino behaviour

	Type of behaviour	Description
1	Grazing	Approaches grasses and takes into mouth (Laurie 1982; Jnawali 1995)
2	Browsing	Approaches bush, tree twigs, takes into the mouth. (Laurie 1982; Owen-Smith 1988)
3	Wallowing	Almost all parts of body dip into mud and water (Laurie 1982; Dinerstein 2003; Hazarika & Saikia 2012)
4	Resting	Animal is in resting position (lying and sitting) inactive and relaxed (Laurie 1982)
5	Walking	Animal moves forward attentively (Laurie 1982; Dinerstein 2003)

### Results: Seasonal activity patterns of rhinos

**Pre-monsoon period.** In this period (March–May), rhinos were tracked 1,326 times and observed 1,089 times (82%). Adult males, adult females and calves were observed on 425 (32%), 398 (30%) and 266 (20%) occasions respectively. Researchers were unable to locate rhinos on 237 (18%) occasions due to difficult terrain and/or dense vegetation and when rhinos were wallowing. There were no marked behavioural variations observed among the three age/sex groups, based on the average time engaged in different activities as a proportion of total observation time (Fig. 2, Table 3).

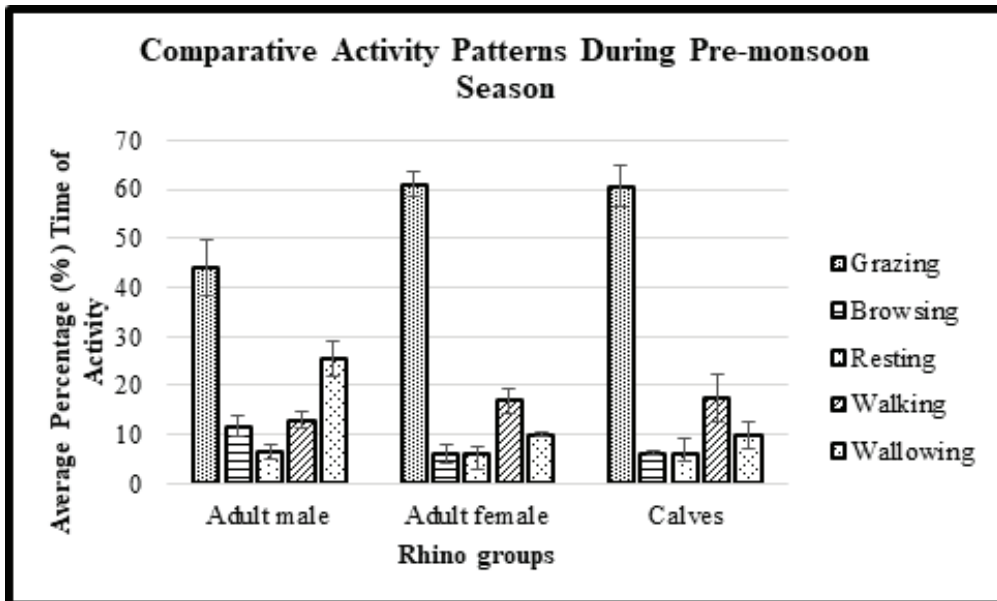


Figure 2. Comparative activity patterns of translocated rhinos in Manas National Park, India: pre-monsoon season (see Table 2 for descriptions of activity patterns).

Table 3. Time (mean  $\pm$  SD) engaged in different activities by translocated greater one-horned rhinos in the Manas National Park, India, as a percentage of total observation time, during pre-monsoon and monsoon seasons

Activity	Pre-monsoon			Monsoon		
	Adult males	Adult females	Calves	Adult males	Adult females	Calves
Grazing	44 $\pm$ 6	61 $\pm$ 2.6	61 $\pm$ 3	54 $\pm$ 4.2	69 $\pm$ 4	59 $\pm$ 1.4
Browsing	12 $\pm$ 2.07	6 $\pm$ 1.8	6 $\pm$ 0	0	0	5 $\pm$ 3.2
Resting	6 $\pm$ 3	6 $\pm$ 1.5	6 $\pm$ 3	1 $\pm$ 0.5	4 $\pm$ 2	6 $\pm$ 1.4
Walking	13 $\pm$ 1.6	17 $\pm$ 5	17 $\pm$ 5	20 $\pm$ 4	17 $\pm$ 4	24 $\pm$ 13.1
Wallowing	25 $\pm$ 6.3	10 $\pm$ 0.4	10 $\pm$ 3	25 $\pm$ 1.3	10 $\pm$ 1	6 $\pm$ 2

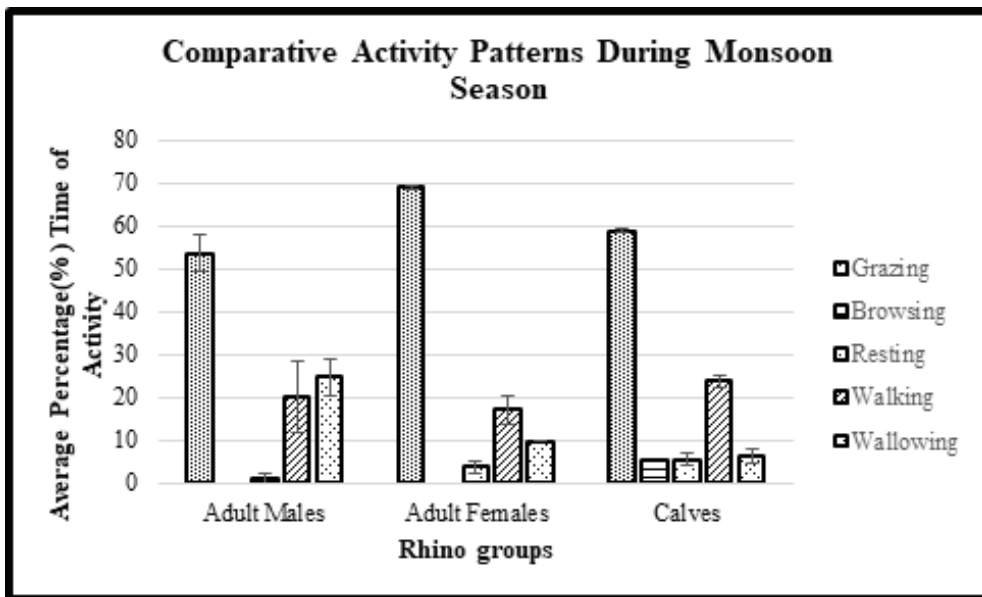


Figure 3. Comparative activity patterns of translocated rhinos in Manas National Park, India: monsoon season.

**Monsoon period.** During the monsoon (May–September), rhinos were tracked 1,840 times, and observed 1,323 times (72%). Adult males, adult females and calves were observed on 654 (49%), 367 (28%) and 302 (23%) occasions respectively. Researchers were unable to locate rhinos on 517 (28%) occasions (Table 3). During the monsoon a non-uniform pattern of behaviour was observed among all aged groups (Fig. 3).

**Retreating monsoon.** This is a short season (October–November). During this period, rhinos were tracked 642 times and observed 491 times (76%). Adult males, adult females and calves were observed on 186 (38%), 171 (35%) and 134 (27%) occasions respectively. Researchers were unable to locate rhinos on 152 (24%) occasions (Table 4). During this season no specific behavioural variations were observed among the three groups of rhinos (Fig. 4).

Table 4. Time (mean ± SD) engaged in different activities by translocated greater one-horned rhinos in the Manas National Park, India, as a percentage of total observation time, during retreating monsoon and winter seasons

Activity	Retreating monsoon			Winter		
	Adult males	Adult females	Calves	Adult males	Adult females	Calves
Grazing	65 ± 4	67 ± 9	83 ± 1.6	37 ± 3.25	51 ± 3.3	53 ± 2.7
Browsing	13 ± 7	0	1 ± 0.8	23 ± 2.1	12 ± 7.05	10 ± 3.2
Resting	2 ± 1	1 ± 1	3 ± 1	11 ± 2.1	5 ± 1.9	8 ± 1.04
Walking	12 ± 4	20 ± 10	9 ± 3	15 ± 3	23 ± 4.06	20 ± 3
Wallowing	8 ± 5	12 ± 4	4 ± 2.4	14 ± 0.7	9 ± 1.9	9 ± 2.1

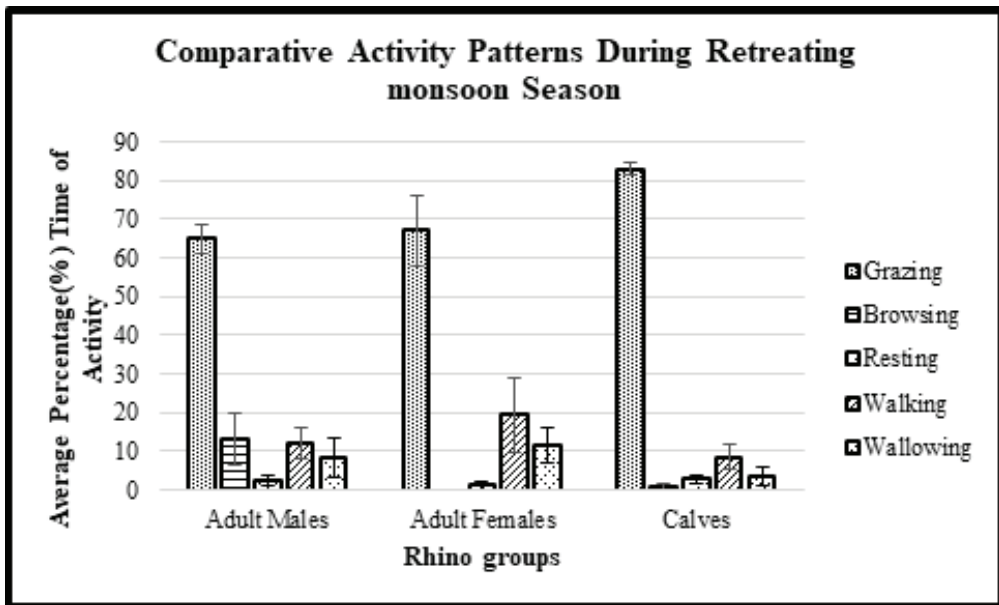


Figure 4. Comparative activity patterns of translocated rhinos in Manas National Park, India: retreating monsoon season.

**Winter season.** During the dry winter season (December–February), rhinos were tracked 1,133 times and observed 808 (71%) times. Adult males, adult females and calves were observed on 464 (57%), 161 (20%) and 183 (23%) occasions respectively. Researchers were unable to locate rhinos on 325 (29%) occasions (Table 4). During the winter season distinct variations in behaviour were observed among the all aged groups of rhinos (Fig. 5).

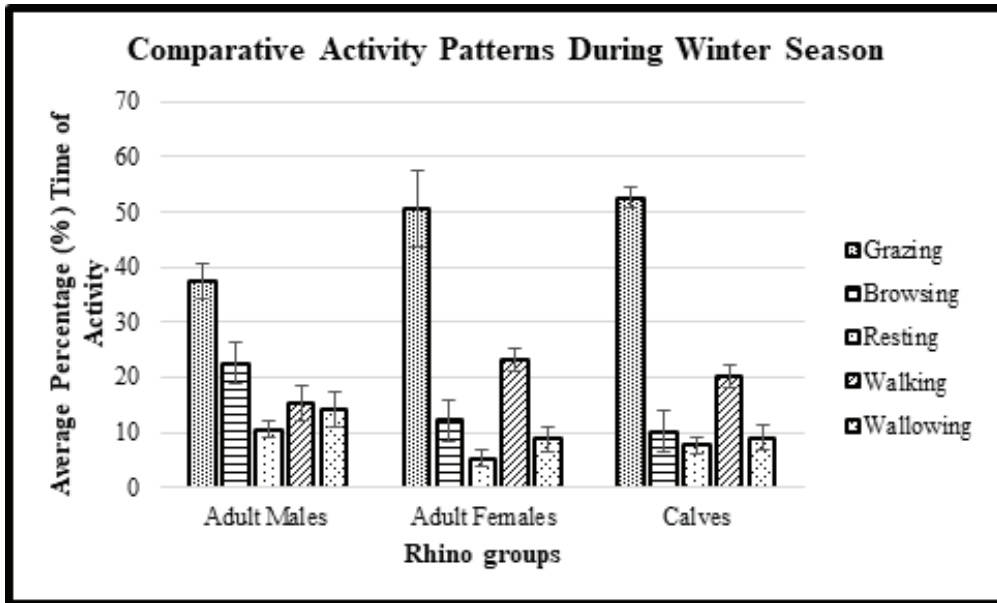


Figure 5. Comparative activity patterns of translocated rhinos in Manas National Park, India: winter season.

## Discussion

Following their release, all rhinos started to explore their surroundings to find the most suitable habitat in and around the release site. It is assumed that this exploration might help rhinos to become familiar with and gradually settle in their new environment (Dutta et al. 2015). According to Tal and Saltz (2014), a reintroduced animal changes its behaviour when it becomes more familiar with the new environment. Because adult male rhinos R1 and R2 were first to be introduced at MNP, they directly or indirectly influenced the establishment of home ranges and the behaviour of the later released rhinos.

The three adult males (R1, R2 and R5) and four adult females (R3, R6, R8 and R13) monitored had overlapping range areas in Bansbari and Bhuyanpara ranges. Adult males R1 and R2 maintained loosely defined territories in Bansbari range. Adult male R5, which was introduced 3 years later, mainly stayed in the easternmost parts of Bhuyanpara range, occasionally visiting the eastern part of Bansbari to seek the company of adult females. Fighting incidents were very common among males when they confronted each other. In these fights, R5 was always a loser and then moved away from territories occupied by R1 and R2.

Following release of the females and their calves they were frequently seen in association with

dominant males, for example in feeding and wallowing activities. However in response to domineering behaviour by the males, the females and their calves subsequently moved away from the male territories to areas where they had more solitude. Adult female R8 (without calf) frequently changed her location in the period following her release. Later, she established an association with adult male R2.

A distinct seasonal variation in activity was observed among rhinos. Maximum grazing activity was observed in the monsoon and in the retreating-monsoon season, and minimum grazing during the winter season. According to Laurie (1982), the activity pattern of rhinos depends on factors such as diet and abundance of food resources. In Rajiv Gandhi Orang National Park, Assam (RGONP), Hazarika et al. (2013) found that there was less grazing in the monsoon season when floods prevented rhinos from grazing. MNP does not experience flooding problems and the availability of food resources peaked during the monsoon and retreating monsoon. During the dry season, food and water are limited, and minimum grazing activity was observed. However, browsing activity increased in this season among all age groups of rhinos. While the GoH is primarily a grazer, it is able to turn to browsing when availability of grasses are limited. During the entire period, the browsing activity of adult males was comparatively greater than that of adult females and calves.

Resting activity was at a maximum during the dry winter

season and the pre-monsoon season. Maximum resting activity was observed among adult males during winter, and in rhino calves during the pre-monsoon season. In their new habitat, adult males were observed to move from one place to another in search of a female companion. It is natural that they would be more exploratory when there were so few rhinos in such a vast area. Dinerstein (2003) suggests that adult males spend much energy in defending their territory and keeping track of females, so they do not have much time for feeding but they have to devote time to resting.

Throughout the study period, maximum walking activity was observed in the monsoon season and it was highest among adult females with calves. Wallowing was the dominating activity after grazing among translocated rhinos at MNP, with increased wallowing in the monsoon season, and adult males wallowed more often than adult females and calves. Laurie (1982), Owen-Smith (1988), Patar (2004), Dinerstein (2003) and Hazarika et al. (2013) all suggest that wallowing may be a part of behavioural adjustment to heat stress. It was observed that rhinos wallowed in all seasons but wallowing activity was greatest during the hot monsoon season. At RGONP, maximum wallowing activity was reported during monsoon 41.3% (Hazarika et al. 2013). Similar kinds of wallowing behaviour were also found by Laurie (1982), Dutta (1991), Jnawali (1995), Dinerstein (2003), Patar (2004) and Bhattacharya (2011).

Dutta (1991) described that rhinos prefer to wallow in mud or static water bodies, but never in running water like streams or river. In contrast to this finding, translocated rhinos in MNP were observed to wallow in running water channels regularly in both Bansbari and Bhuyanpara ranges. During winter season, when water sources dried up, rhinos (and other animals in the Park) depended on perennial water sources. In Bansbari range, a total of 28 water sources and in Bhuyanpara range 14 perennial water sources were regularly observed to be used by rhinos.

Rhinos sometimes ate aquatic plants found along the shallow river bottoms and then moved outside the national park boundary. During the pre-monsoon season, adult males along with adult females in the Bansbari range moved outside the Park boundary, and entered shallow water bodies to the south of the Park to feed aquatic weeds.

These plants include species like *Hydrilla verticillata*, *Hydrocotyle sibthorpioides*, *Pistia stratiotes*, *Vallisneria spiralis*, *Hymenachne psudointerrupta*, *Lemna perpusilla*, *Leersia hexandra*, etc. This study has shown that rhinos not only wallow for thermoregulatory purposes, but also display a preference for aquatic plants. So, there is ample scope to study wallowing time and behaviour, as well as wallowing locations, in the future.

It was found that there was no marked differences in behaviour patterns of translocated rhinos at MNP and behaviour of other wild rhinos reported by Laurie (1982), Jnawali (1995) and Dinerstein (2003) in Nepal, and Dutta (1991), Patar (2004), Bhattacharya (2011) and Hazarika et al. (2012, 2013) in Assam. The overall behaviour budgeting as well as preferences of different habitat or births of new born calves indicated that translocated rhinos have adapted well in MNP.

## **Conclusion**

The establishment of a new GoH population at MNP through the wild-to-wild translocation program under Indian Rhino Vision 2020 opened up a new dimension in conservation efforts for this magnificent pachyderm. It can be expected that rhinos translocation program at MNP will also contribute to the mixing of genes from individuals from PWS and KNP populations. These behaviour observations maybe helpful in other countries where there are plans to establish new populations of GoH in the near future.

In MNP, improvement of protection as well as patrolling infrastructure and continuous community support of conservation helps to secure the situation of MNP. Swargowari (2012) stated that the rhino introduction program contributed much to an increase in ecosystem integrity, when rhinos were present alongside other wild animals including elephants, tigers and wild buffalos.

The GoH population at MNP is doing well and the rhinos have started breeding. However, while the newly established population is doing well, poaching remains a significant threat. During 2011–2016, 10 translocated rhinos were poached including 4 (R1, R2, R5 and R8) of the studied animals. Three of these animals were adult males, which is likely to affect population growth pattern of newly established rhinos. A population viability analysis by IUCN Conservation Breeding Specialist Groups carried out in 2015 indicated that unless poaching is eradicated, continued reintroduction of rhinos is unlikely to result in a viable population in MNP and the rhino population faces threat of extinction in the next two to three decades.



Therefore, more intervention is required for the improvement of the entire protection system of the National Park near future. Only the improved protection will enable the breeding rhino population at MNP to survive and grow.

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