

A study on the behaviour of Great Indian One-horned Rhino (*Rhinoceros unicornis* Linn.) in the Rajiv Gandhi Orang National Park, Assam, India

B.C. Hazarika¹ and P. K. Saikia²

¹Department of Zoology Mangaldai College, Mangaldai - 784125, Assam, India

²Department of Zoology, Gauhati University, Guwahati - 784014, Assam, India

Author for correspondence: buddhin@sify.com

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ABSTRACT

Great Indian One-horned Rhino (*Rhinoceros unicornis*) is a Schedule-I species of the Wildlife (Protection) Act, 1972 confined only in few pockets of India and Nepal. The present study deals with behavioural ecology of Indian Rhino in Brahmaputra Flood Plain representative area - Rajiv Gandhi Orang National Park which is the only home of this primitive mammalian species on the northern bank of river Brahmaputra. Study revealed two Fundamental/ Basic types of behaviour - (1) Breeding and (2) Non breeding behaviour. Altogether 14 major behavioural patterns were categorized and these are related to their daily activities. . Apart from those major types, certain subtypes were also categorized on Major behavioural types. Study also found that, the behavioural patterns of *Rhinoceros unicornis* has relationships with their conservation measures. The relationship is even more significant because the knowledge of the behaviour is essential for successful translocation and *in-situ* conservation

Keywords: *Rhinoceros unicornis*, behaviour, breeding behaviour, non-breeding behaviour, Rajiv Gandhi Orang National Park, translocation, in-situ conservation

Behaviour is the response of extrinsic factors guided by intrinsic factors (gene) of an individual of a species. Hence, the behavioral pattern of one species is quite different from the other. Again, the individuals or a group of same species shows the variation of behavioral pattern in response to habitat conditions (e.g. availability and distribution of food resources), environmental factors (climatic factors) as well as the social factors. Being a solitary and primitive herbivorous mammal, Indian rhino (*Rhinoceros unicornis*) shows distinct behavioral characteristics. Laurie (1978, 82) has done remarkable studies on behavioral activities (both diurnal and nocturnal), which covered feeding behaviour, drinking behaviour, aggressive behaviour, non-breeding play behaviour and reproductive behaviour etc.

Various scattered information are available, regarding the behavioral pattern of *Rhinoceros unicornis*, such as aggressive behaviour (Lahan, 1974), daily activity (Bhattacharya & Pal, 1982; Venugopal *et al.* 1994; Yadav, 2000), feeding and wallowing behaviour

(Bhattacharyya, 1991; Ghosh, 1991; Patar, 2005), breeding behaviour (Buechner & Mackler, 1975; Buechner *et al.* 1975; Kakati & Rajkonwar, 1972), sexual behaviour (Ripley 1967), social interaction (Dixon & Macnamara, 1981), play behaviour (Mackler & Buechner, 1978), food and feeding behaviour (Patar, 1977; Laurie 1978,82; Ghosh 1991; Bhattacharyya, 1991), territorial behaviour (Ripley, 1967) and also human-rhino conflict (Jnawali, 1988; Hazarika & Saikia, 2005). However, those studies were not related to any conservation strategy. Therefore, the present study aimed to find out the definite conclusion for comprehensive conservation strategy for Indian Rhino in Rajiv Gandhi Orang National Park as well as in Brahmaputra flood plain habitats.

Study Area

The Rajiv Gandhi Orang National Park (co-ordinates, 92°15'-92°27'E and 26°29'-26°40'N) is situated in the north bank of the river Brahmaputra and within the administrative boundary of Darrang

and Sonitpur districts of Assam, India (Fig. 1). The study area is located at about 130 km apart from the state capital city Guwahati and under the jurisdiction of Mangaldai Wildlife Division, Department of Environment and Forests, Government of Assam.

The eastern side of the study area is bounded by Borsola area and river Brahmaputra of Sonitpur district, southern side by the river Brahmaputra, western side by the tributary Dhansiri and Bogoribari village area and the northern side is bounded by Nalbari and Ronggora villages of Darrang district. The study area comprises of alluvial floodplains of the river Brahmaputra. In fact, the complete study area is an alluvial terrace and the Rajiv Gandhi Orang National Park could be divided into two halves i.e. lower Orang and upper Orang. The lower Orang

portion is more recent origin, whereas the upper portion to its north is separated by high bank, traversing the park from east to west. The terrain is gently sloping from North to South. The altitude of the study area ranges between of 45-75 m above MSL.

The entire protected area was a human habitat area till the last decade of 19th century (Talukdar and Sharma, 1995). Prior to declaration of Orang as a 'Game Reserve' in 1915, different ethnic groups occupied the entire study area. Two large tributaries of the river Brahmaputra, namely Dhansiri and Panchnoi are associated with numbers of streams and *nallah* that criss-crosses the park and became the source of water for the entire habitat. The area was declared as National Park on 8th April 1999.

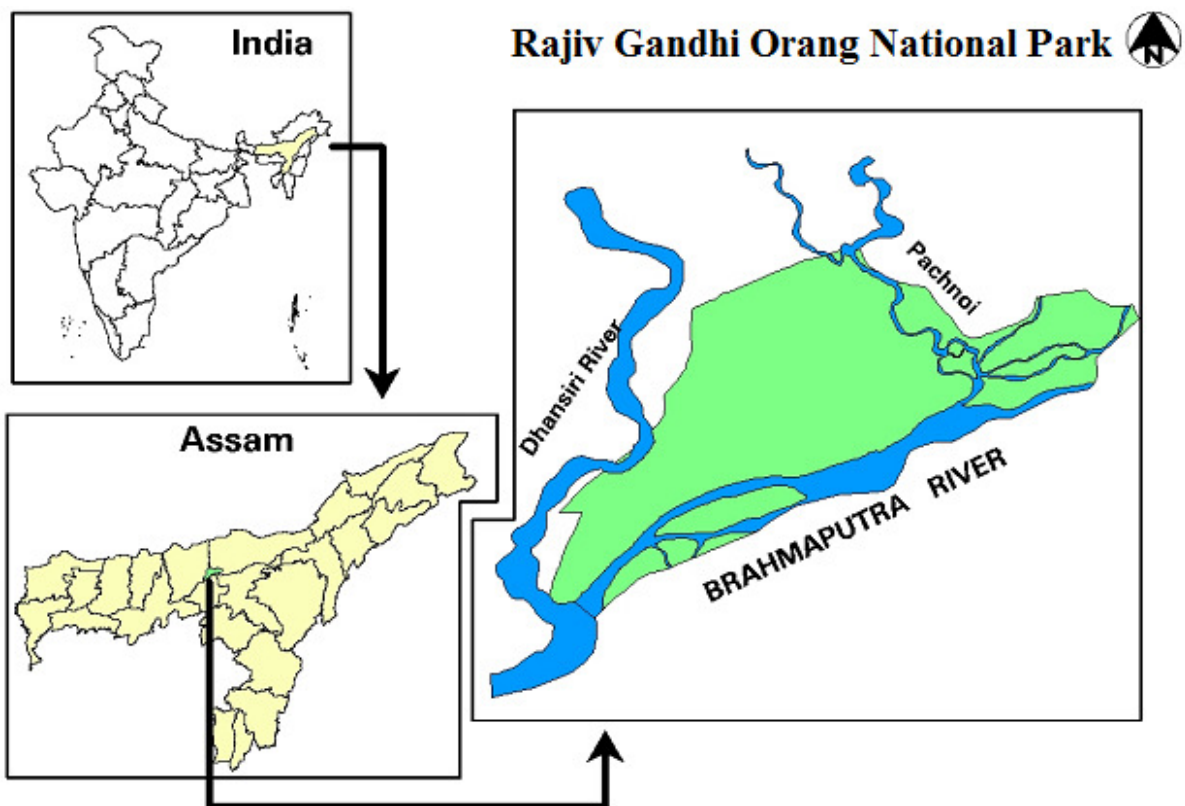


Figure 1. Location map of Study Area (Rajiv Gandhi Orang National Park).

Methodology

Sampling methods

During “Dawn to Dusk” follow up action of Indian Rhino, the occurrences of reproductive display, feeding, wallowing, locomotion and aggressive behaviour etc. were recorded (Laurie, 1978; 82), using *Scan Animal Sampling* and *Ad. Libitum Sampling* methods (Altman, 1974).

During field survey in Rajiv Gandhi Orang National Park, presence of newborns, calf and dung heaps were recorded with their frequency of occurrences. The GPS locations of dung heap sighted and patterns of tracks (*Dandis*) were also recorded. Apart from that, the monthly visits of each fringe villages were made to record the crop-depredation. The information of crop damage and destruction of other cultivated plant species were investigated at the fringe village sites and recorded in the notebook. If there were any information of human injury or causality of both the human and Indian Rhino, it was recorded after interview. The stray out information of Indian Rhino from the park area was collected and the GPS locations of visiting sites and the status of the Rhino after stray out were also recorded. For the observation of behaviour, the terms and nomenclature of the behaviour were used from the published literature (Laurie, 1978, 82; Ghosh, 1991; Bhattacharyya, 1991) and some behaviour like soil licking; local migration, dive feeding and dragging

etc. were newly coined for the study. The study was carried out from 2004-06. The collected data on different behavioural patterns, habitat utilization patterns etc. were analyzed graphically, using Microsoft Excel software and quantification of each behaviour was computed to get the actual time allocation for different activities of Indian Rhino.

Results

All the observed behavioural patterns of Indian Rhino were divided into two basic types such as (a) Breeding behaviour and (b) Non breeding behaviour. The breeding behaviours were related to breeding activities or associated with breeding purposes. The other behaviours, which were not associated with breeding purposes, were grouped together as non-breeding behaviour.

Cataloguing of behaviour

Altogether 14 major behavioural patterns were categorized for Indian Rhino in Rajiv Gandhi Orang National Park, those were such as (1) Feeding, (2) Locomotion, (3) Comfort, (4) Vigilance, (5) Non-breeding agonistic behaviour, (6) Non-breeding play behaviour, (7) Local migration, (8) Crop raiding behaviours, (9) Vocalization, (10) Courtship behaviour, (11) Mating behaviour, (12) Breeding play behaviour, (13) Breeding Vocalization and (14) Breeding agonistic behaviours.



Figure 2. One-horned Rhino (*Rhinoceros unicornis* Linn.) in the Rajiv Gandhi Orang National Park, Assam, India

Apart from these major types, certain subtypes were also categorized, such as under locomotion three subtypes were identified (i) Walking (ii) Galloping and (iii) Running, under feeding behaviour, six subtypes, such as (i) Browsing (ii) Grazing (iii) Drinking and (iv) Dive-feeding (v) Breast feeding and (vi) Geophagy. Under non-breeding agonistic and breeding agonistic behaviour, five subtypes were categorized such as (i) Snorting (ii) Threat Display (iii) Chasing (iv) Attacking and (v) Escaping behaviour. Under comfort behaviour, three sub-types were categorized, such as (i) Resting (ii) Sleeping and (iii) Wallowing. Under wallowing behaviour, two subdivisions such as (a) Mud wallowing and (b) Water wallowing. In case of breeding behaviour, two major types of behaviours were found such as (1) Courtship behaviour and (2) Mating behaviour and under courtship three subtypes such as (i) Touching (ii) Licking and (iii) Chasing behaviour, whereas mating behaviour was also categorized into two subtypes (i) Mounting and (ii) Dragging behaviour.

Description of behavioural patterns

A. Non- breeding behaviour

1. Feeding behaviour

The feeding or foraging behaviour was associated with the foraging movement for searching food items, consumption of food in the habitat and also techniques used for food intake in different habitat types and breast feeding by calf etc. It also included all the feeding types such as feeding on grasses, consumption of leaves or branches of trees, consuming soil, as well as drinking of water etc. On the basis of different feeding activities, the feeding behaviours were again categorized into six sub types, such as

- (i) **Grazing:** Grazing included the behaviour of Rhino during grass intake, using prehensile upper lip, during the collection of short grasses and herbs from the ground zone. If roots come along with the grasses it also immediately separated from it and discarded into the ground.
- ii) **Browsing:** Rhino occasionally intake leaves, tender twigs, by raising its head at a horizontal position with ground. In this posture, Rhino performed inward jerk of the head and mouth. Incisor teeth's were also used during browsing

process. Rhinos occasionally consume bark, fruits and seeds of edible shrubs and trees.

- iii) **Geophagy** (Soil licking/eating): Rhino frequently consume soil from some particular location of the habitat. The soil licking behaviour was performed by using tongue. During the process Rhino forwarded its tongue tip and licking the soil and consume it. Apart from that, incisor teeth were also used to dig the selected soil and occasionally consumed a bulk of soil itself. During soil licking, they created a deep and wide den like structure. Same soil licking spots were also observed to use by several Rhino at different times.
- iv) **Breast feeding:** Rhino calves performed breast-feeding activity by sucking the mother's nipple, which was found to almost same with other herbivorous animal. But, Rhino calves were observed to suck mother's nipple from the either sides and occasionally from back side of the mother. The sucking activity found to be continued for a period of 20-30 minutes. Occasionally the process was continued, when mother started moving from one place to another.
- v) **Drinking:** Rhinos were found to drink water from *beels*, streams, ponds and wallowed sites, irrespective of water condition. During drinking process, the Rhino immersed its mouth into the water body and suck it and engulfed the water. The drinking activities were normally observed during morning and evening time.
- vi) **Dive feeding:** Dive feeding is a technique of feeding on under-water or submerged food plant like *Hydrilla*, *Vallisneria* etc. Rhino immerse their head in to water and very often dive into deep water, bite and collect mouthful of grasses and resurface again. The grasses collected were chewed and engulfed above water surface only. The individual remains in water for more than 2 min to collect food plants. The dive feeding behaviour was very common at mid-day period also, when Indian Rhino in Rajiv Gandhi Orang National Park was generally found in comfort behaviour. In Rajiv Gandhi Orang National Park, dive feeding behaviour was observed especially during Retreating monsoon and monsoon season.

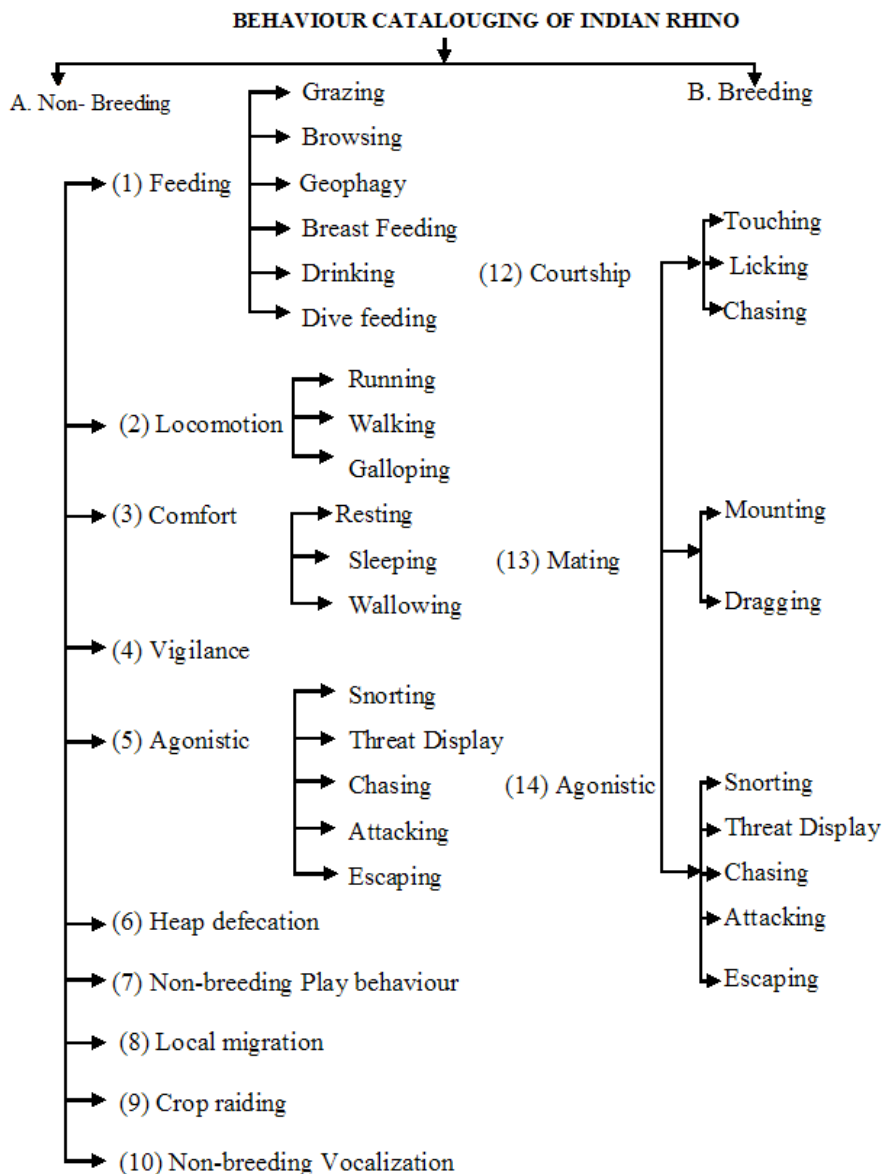


Figure 3. Flow chart of behavioural cataloguing of Indian Rhino during breeding and non breeding period at Rajiv Gandhi Orang National Park

2. Locomotion

The locomotion behaviour is the movement pattern of Indian Rhino from one place to another for their daily activities. During locomotion, the movement patterns may be performed in a normal way or by running from one place to other. Those were such as walking fast to cover a distance from one place to another (Galloping), walking normally, running etc. On the

basis of their movement pattern the locomotion can be divided into three sub- types such as-

- i) **Running:** Running was the very fast movement of Rhino in one particular direction, keeping the head downward. While in action, both the fore legs as well as hind legs as if in air at the same time. This behaviour was observed during the time of both breeding and non-breeding

agonistic behaviour possession and also in escaping and fleeing behaviour.

- ii) **Walking:** Walking was the movement of the body of Rhino in a slow and steady manner with moving the alternate legs of fore and hind leg, simultaneously.
- iii) **Galloping:** Galloping is a particular type of faster movement than walking but, slower running locomotion rather than fast running, which has a definite rhythm. An example is when Rhino goes away suddenly due to disturbance from intruders.

3. Comfort behaviour

The comfort behaviour includes the body postures with cessation of almost all physical activities or it is a state of motionless body postures or comfortably staying. The comfort behaviour was divided into three sub-types, such as, resting, sleeping and wallowing.

- i) **Resting behaviour:** The resting behaviour includes the posture of the body either in standing or in lying condition on ground but, eyes were kept open at all time. During resting state, the Indian Rhino became alerted and kept vigil with their erected ear pinnae.
- ii) **Sleeping behaviour:** The sleeping behaviour is the motionless state of animal like the resting behaviour, but the eyes of the animal always remained closed. In this state, the animal occasionally spread out all its legs on the ground and become flat, so it looks like a dead Rhino. The alertness of the animal in this posture has completely absent, here one person could approach the Rhino very near and could touch the body.
- iii) **Wallowing:** Wallowing is a particular behavioural posture of Indian Rhino, in which the rhino lies on the water holes (mud or water-bodies) especially during day hours. Wallowing behaviour was also divided into two types (a) Mud wallowing and (b) Water wallowing, based on substratum used.
 - a) **Mud wallowing:** It is the process in which the Indian Rhino lies in mud or rolls their body in mud.
 - b) **Water wallowing:** During water wallowing, the Rhino immersed its entire body into the water by keeping only head portion above water surface.

The duration of both types of wallowing varies from few minutes to several hours with or without interval. Most often the wallowing activities found to be solitary, but occasionally up to 11 individuals in a same place were also observed. However, no age-sex specific social bonding was found during wallowing. When other rhinos approached the wallowed site, they shared the same site without conflict. When other animals like elephant approached the site, rhinos stand up and kept vigilance of the situation and go away without interaction when found uncomfortable.

Observation showed that, the Indian Rhino preferred open water or wetland with grasses for wallowing. They generally found to wallow in shallow water wetlands up to the water level below half of the body. The wallowing posture was same with sleeping and resting posture while the lower portion of the body was remained stuck into the mud and upper portion of the body was remained partially movable. Rhino was also found to use only in muddy place for wallowing.

4. Vigilance

Vigilance was the solitary behaviour of Rhino, without performing almost any other activities like feeding, running, walking, sleeping etc., nor did they perform any social interactions. But carefully looked around and continuously watched the intruder or locate the sound. During vigilance, the Rhino erected their head and moves in and around for watching the situation. The ear pinna became erected either vertical or horizontal direction. Sometimes it moved both the direction and tries to locate the sources of sound or object. The eyes and ears were used during the process of vigilance behaviour. During vigilance, the Indian rhino occasionally produced mild sound. The Rhinoceros has found to be very much-alert animal in presence of other animals, especially, the large predators. The vigilance of cow with calf was found to be very active during wallowing than other age sex class. The cow always found to keep an eye on her calf for predators or any other uncomfortable situation. In wallowing posture, the cow was found to vigil and watched for a longer period (up to 90 minutes) without moving.

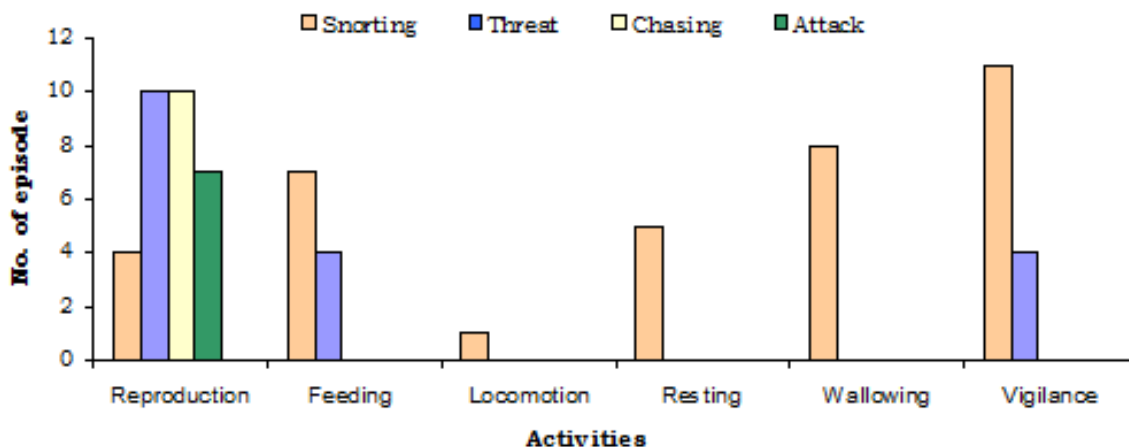


Figure 4. Aggressive behaviour performed by Indian Rhino during different activities in Rajiv Gandhi Orang National Park.

5. Non-breeding agonistic behaviour

Non-breeding Agonistic behaviours were those behaviours, which the Indian Rhino posses for performing threat and threat displays against competitor to chase other intruder from his territory or to defend from unwanted competitor in its own territory. Both male and female Rhino performed agonistic behaviours. The non-breeding agonistic behaviour was categorized into five different sub-types such as

- i) **Snorting:** Snorting was a kind of agonistic threat performing with sound by producing *khaawk...-khaawk...* sound at regular interval to protect its own territory. It was a vocal dominance by adult female or male.
- ii) **Threat display:** A kind of physical aggression where the dominant individual express (erects its head, ear pinna, making a mild sound) for pretending to attack the other individual approaching or being approached.
- iii) **Chasing:** The chasing was a type of aggressive behaviour, which helped to displaced one Rhino by other. The strong individual of Rhino generally chased the weak Rhino or adult Rhino or sub-adult Rhino at a distance longer than its body length.
- iv) **Attack:** The agonistic behaviour of Rhino, which physically attack the opponent and leading to injure of the body. During attack, they generally used incisor teeth and its horn. The attack may be performed from backside of

the animal, when weak animal fled, during charging.

- v) **Escaping behaviour:** Generally, weak animals did not take part in fights or attack. The weak animal goes away from opponent animal or even human, either by running away or by galloping motion. It was a common phenomenon observed for Rhino during non-breeding periods.

The characteristic features of both non-breeding and breeding agonistic behaviour are almost similar. The differences were observed in case of opposite sex aggression. When the estrous female refuses the male, at the same time she was observed to attack her male.

6. Heap defecation behaviour

The Indian Rhino had a tendency to defecate in a particular location, and as a result of continuous deposition of dung at the same spot, leads to form a heap like structure. This type of defecation behaviour was possessed by Indian Rhino alone. In all study blocks the rhino was to defecate only in the form of heap structure.

Altogether 76 number of rhino dung heaps were observed in different blocks of Rajiv Gandhi Orang National Park .The highest number of dung heap was found in block-2 (Figure 5).

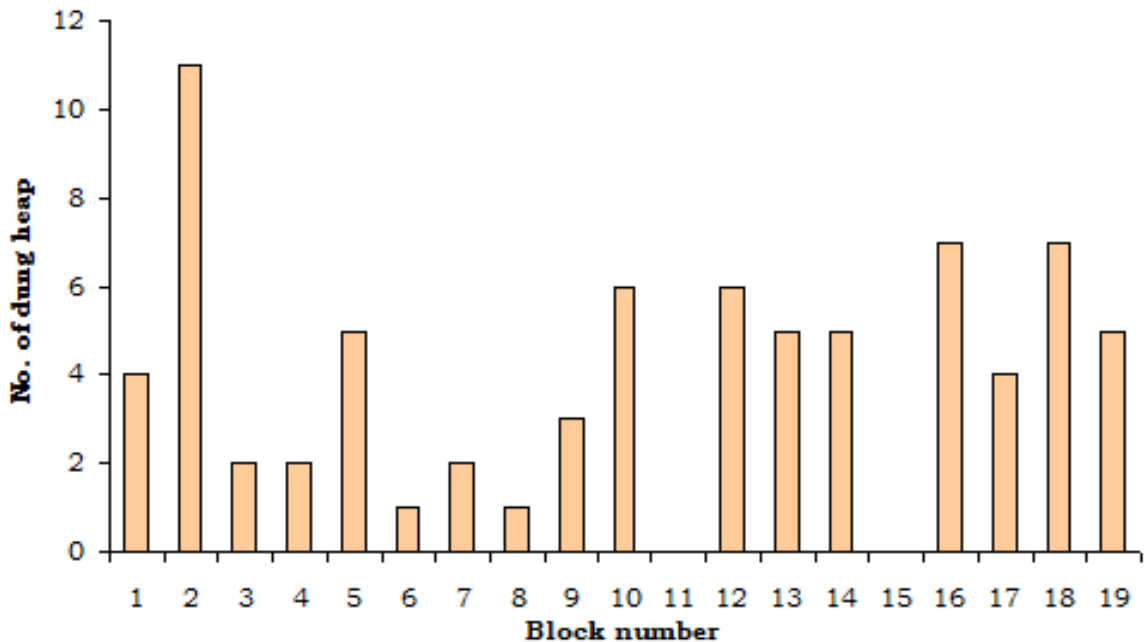


Figure 5. Numbers of Rhino dung heaps during the study found in different blocks of Rajiv Gandhi Orang National Park.

7. Non- Breeding Play behaviour

The Rhino calf performed the non-breeding play behaviour with their mother, when she was engaged in grazing, wallowing or resting posture. In this process, the calf runs a short distance away from the mother and returned back to its mother and touched the mother's body. This play behaviour was found to be continued for several minutes.

8. Local migration

Movement or migration of Rhino from one natural habitat or protected area to other natural areas outside its boundary was categorized as local migration. Indian Rhino in Assam has a common behaviour of travelling from one habitat patch to another and occasionally, the animal covered more than 100 km distance. It has evident that, Indian Rhino, migrates from Rajiv Gandhi Orang National Park to other fringe areas especially at night times, or travelled to long distance in different seasons. During this behaviour, they normally raid the domestic or cultivated crops.

The study found that, the local migration of Indian Rhino was a common phenomenon, they suddenly go out from the population to other destination but never completed their journey or to part of which also returned back to park area. A total of 4 individuals were found to stray out from the park and all of them were adult male. Majority of them were observed during the monsoon season and only one has observed in the Re-treating monsoon season. It was also found that, most of these incidents were taken place during flood season and a few in the winter season. It may be associated with the competition for reproductive resource that resulted straying out some of the comparatively weaker individuals or they intentionally move out of the population in search of mate. This needs further study to find out the reason behind stray out of some of the individuals of rhino from the population. However, most of them who strayed out of the population were fall victim from poaching.

Table 1. Records of local migration behaviour of Indian Rhino in Rajiv Gandhi Orang National Park

Date	Age-sex	Distances of stray out		Final	Remark
		Location	Aerial distance (approx.)		
August, 1988	AM	Mangaldai Town (Sericultural Farm)	35 km	Sent back by the forest official of ONP	
May, 2001	AM	Dalgaon then to south of Kharupetia	10 km	Died due to human atrocities	
October, 2003	AM	Bhuragaon crossing Brahmaputra river	8 km	Sent back by the forest official of ONP	
July, 2004	AM	Chereng Chapori/ Garubandha area	45 km	Stayed there for two months; then sent back	Rhino killed one and injured two people
Sept., 2005	AM	Kharupetia crossing Dalgaon	10 km	Sent back by the forest official of ONP	

9. Crop-raiding behaviour

During field survey, it was found that, the crops of neighbouring villages namely Borsala, Kachari toop, Phata-simalu, Gariapathar, Bezimari, Rangagara, Bhabapur, Chandanpur and Bagoribari located about 0.5 to 2 km aerial distance on the north-eastern side of the park were raided by Indian Rhino in each year. This type of behaviour of Indian Rhino was categorized as crop-raiding behaviour. Most of the damaged was done during fruiting or riping season of paddy crop while the raiding of vegetables and plants took place during vegetative stage.

No structural construction (e.g. Building) was damaged by Indian Rhino during study period. In 90% cases, the adult males visited the areas for crop raiding activity and which was performed during night period. Occasionally, females with calf were found to move around the village areas for crop raiding. However, no injury or death of both Rhino and human being was recorded from any fringe village during the study period.

10. Non-breeding Vocalization

Indian Rhino produces several types of sounds for auditory communication (Laurie 1978, 82). During study, it was observed that, when Rhino fled away after receiving any threat from intruder they produce a moo grunt like sound (*yaeeh...yaeeh...*). The vocalization was also heard, when mother responded to calf. During that, vocalization produces a honk like sound (*beyh...beyh...*). Again, during breeding display, Rhino produces a whistle like prolonged sounds (*fleet...fleet...*). The intensity and duration of vocalization during non-breeding period was shorter than the breeding display. The sounds produced during non-breeding occasions persist not more than

20 seconds. But, it was continued in an average of 1 minute (Range = 40-70 seconds) during breeding season.

Dandi or Track follow behaviour

Indian rhino had behaviour of creating path in the habitat and that path was followed every time when they travelled from place to other. This behaviour of Rhino categorized as *Dandi* or track follows behaviour. Study revealed that, the Indian Rhino followed definite *dandi* in all habitats of Rajiv Gandhi Orang National Park. These were quite distinct at habitat, not in wetland. A similar characteristic of dandi or Rhino-track was also observed in scrubland marshy land habitat, but, *dandis* were zigzag and criss-crossed manners in marshy land.

B. Breeding behaviour

The behavioural postures performed by Indian Rhino during breeding season or only during breeding purposes has categorized as breeding behaviour. Two major types of breeding behaviour were categorized (1) Courtship behaviour and (2) Mating.

1. Courtship display

Courtship took place between adult male and adult female before mating. The courtship behaviour was divided into five subdivisions. Such as-

i) Touching: Touching behaviour was found to be performed by two partners by rubbing the body parts (by adult male and female) of Indian Rhino during pair formation. This activity continued several minutes. Flehmen (smelling of female genital) and curling of lips. The bull keeps its chin

on the rump and shoulder of the female after acceptance of the female in all observed cases.

After touching the next behaviour observed was licking the body of each other.

- ii) Licking:** Licking behaviour was observed as a post effect of touching behaviour of adult male Rhino or female Rhino with their prehensile tongue. The licking of body parts was performed rapidly by the opposite sex.
- iii) Chasing:** The chasing behaviour is a part of courtship behaviour when it was performed during breeding display. During this process, the adult male chased the adult female and the male running after female with very high speed. During this process, both the animals covered sometimes more than 500 meters of distance. This was an act, to achieve the accessibility of an adult female for potential mating by an adult male Rhino.

A total of 31 events of mating display were recorded during the study period, of which 87.9% of mate selection were initiated the adult male, whereas only 12.1 % (Figure 6) was initiated by adult female. But the successful mating was performed only when the female accepted the adult male for mating.

It was observed that during courtship and mating, the female often run away or walks fast with male on her back, leading to severe injury of male on his hind legs. Occasionally female rhino was also got injured during this process. Females were occasionally become aggressive during courtship, resulted to physical attack by females to her male mate. Again it was observed that, the male and the female rhino get minor injury, while approached to each other during courtship.

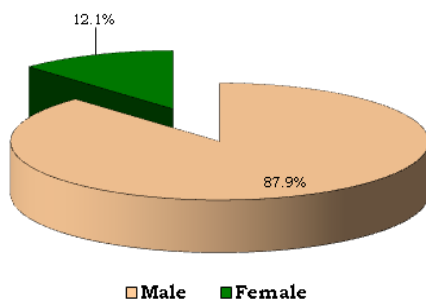


Figure 6. Mate initiatives by Indian Rhino in Rajiv Gandhi Orang National Park.

2. Mating display behaviour:

When courtship display was successful, the female become submissive and agree for mating or copulation. Mating behaviour was found to be completed with two sub-types of behaviour such as (i) Mounting and (ii) Dragging.

- i) Mounting:** Mounting is the process of riding of male on the female back keeping forelegs on her flank (or rump) for copulation purpose. Mounting continued more than hours, when it breaks down.
- ii) Dragging:** Dragging behaviour was found to be the act of copulating male and female Indian Rhino, in which female carried the male on her back to a distance more than 60-150 m. (n=4) and formed a track in the dense grassland, scrubland, woodland or marshy land. During this process male generally could not walk properly with their two hind legs, but being dragged above the substratum. This behaviour indicated that, female must be strong enough to drag the huge male body for a long distance of 150 meters on the rough surface of the tracks in the habitat.

After completion of mating the male dismounted immediately and the female slowly walked away and entered into the tall grassland, and become disappeared. But, occasionally the female started to graze at a distance of about 50-60 meters from the dismounted male immediately after mating. But, after completion of mating, the males stood there for at least 3 minutes and started to graze slowly. No further association was observed after completion of mating.

Although the sightings of mating behaviour were very less, it was observed throughout the year and more in numbers during February, October and December (Figure 7). This indicated that, the Indian Rhino has no definite breeding season.

Breeding Agonistic behaviour

Like the non-breeding agonistic behaviour, Indian Rhino displays agonistic behaviour, which can be termed as breeding agonistic behaviour. This type of agonistic behaviour was displayed by both male and female individuals. The characteristic features of non-breeding agonistic behaviour and breeding agonistic behaviour were almost same.

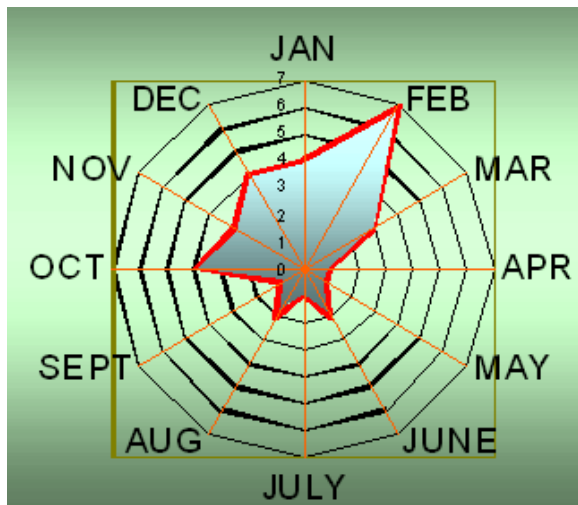


Figure 7. Monthly variation of mating behaviour of Indian Rhinoceros in Rajiv Gandhi Orang National Park

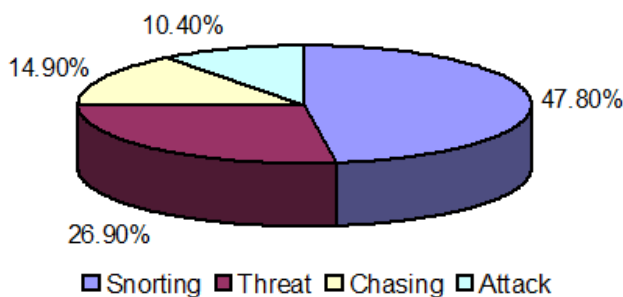


Figure 8. Modes of Aggression of Indian Rhino in Rajiv Gandhi Orang National Park.

Very less number of agonistic interactions was observed for Indian Rhino in Rajiv Gandhi Orang National Park. Of the total 71 episodes of aggressive behaviour, recorded during study period, 31 agonistic interaction followed by 15 vigilance, 11 feeding, 8 wallowing, 5 resting and lowest, 1 aggressive behaviour was observed during locomotion (Figure 7). Snorting was the most common (47.8%) type of agonistic behaviour to express aggression by Indian Rhino followed by threat (26.9%), chasing (14.9%) and attack (10.4) (Figure 8). Again, it was also observed that, among agonistic behaviour, snorting was the common mode of aggression during all major activities pattern (Figure 3).

Discussion

Behavioural ecology is the most important aspect for the conservation of Indian Rhino in its natural

habitat. Apart from that, being the most primitive herbivorous mammals, the Indian rhino possess some important behavioural features that directly or indirectly related to its survival perspectives measure. Again, some of the behaviours of Indian rhino are itself responsible to victim of poachers. During mating display, female normally runs up to a higher distance of 2-3 kms or even more. In doing this, both the individuals often receive severe injury. Since mating take place throughout the year, physical injury is a common phenomenon of Indian Rhino, which occasionally resulted to death. Again, the predation of Rhino calf by tiger is a common phenomenon in Rajiv Gandhi Orang National Park as the Rhino calfs are found throughout the year. This predation effect on rhino calf by tiger was also reported by Talukdar (2002) in Kaziranga National Park of Assam. Again, the mortality of Indian rhino calfs is common during seasonal flood in each year. Therefore, the protection

of Rhino calf during seasonal flood is very much essential in lower Orang habitat by constructing highlands or platform.

The presence of very less sweat glands in Rhino skin leads to rigorous wallowing activity of Indian Rhino during warm days. This wallowing activity regulates the body temperature as well as exo-parasites of their habitats. In the present study, the Indian rhino found to wallow in a solitary manner and occasionally occurs up to 11 individuals wallowed in a same wetland within a minimum distance of 5-10 meters. This community wallowing activity of Indian Rhino was also reported by Laurie (1978, 82) and Ghosh (1991). Ghosh (1991) states that, under very stressful condition more than one rhino can occupy wallow pool or they wallow in solitarily cow calf pair wallows together. As the duration of wallowing activity is varies from few minutes to above one hour without any break, hence the poachers take the advantage and go for hunting. Again, while in vigilance, the Indian rhino keep watching of any intruder for a long duration without moving, so, poachers are successful to kill the Rhino. The occurrence of wallowing behaviour of Indian Rhino especially during day hours indicates that, the Rhino avoid dark for its own protection from large predators and poachers. Dutta (1991) also reported in his study that, Rhino seldom wallows during night hours. The wallowing is highest during the summer and almost absent during winter. During monsoon Indian rhino wallows from dawn to dusk. The posture of wallowing is similar to that of sleeping or resting i.e. the lower portion of their body remains stacked into the mud while other upper portions of the body remains free, hence it is a part of comfort behaviour. It also rolls in the mud by touching the mud with its backbone portions and mud stacked into their whole body. The stacked muddy cover over the whole body of the rhinos dries up and helps to protect disturbance from flies. Apart from that, the Indian Rhino travelling from one place to another place within their habitat; using same track and this track follow behaviour open up a door for Indian Rhino for poaching. The poachers take the advantage of track follow behaviour of Rhino and set up a pitfall trap in fresh track to kill the animal very easily. Again, if the poachers identified a very fresh *dandi* (track) they monitor it for easy shooting. Similarly, the Indian Rhino has a tendency to defecate in a particular point. This peculiar nature of Indian Rhino also threatened for being victim of poacher.

The local migration behaviour of Indian Rhino as observed in Rajiv Gandhi Orang National Park is similar to the behaviour Indian Rhino as reported by Laurie (1978,82) in Chitwan Terai habitat of Nepal. This is a very common behaviour of Indian Rhino for searching suitable habitat for re-establishing a separate population Laurie (1978, 82) also reported the local movement behaviour of Indian Rhino in Nepal. This local migration may be a cause of inter-individual competition for mate resources or dominance of one strong male over adult females during mates. Although, a large numbers of Indian rhino go out from the protected area, for searching around habitat often fall into victim of poachers.

The finding of crop depredation behaviour of Rhino is a new dimension of threat for its conservation perspective. This crop depredation leading to human-Rhino conflict, although it is not very serious. The fringe villagers are often stressed for such crop depredation behaviour of Rhinos that may lead to killing of Indian Rhino in near future. Therefore, the park authority should provide special attention towards crop-depredation of Rhino within fringe village.

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