Determining Population size and Demography of Great Indian One-horned Rhino-*Rhinoceros unicornis* in Pobitora Wildlife Sanctuary, Assam India

Bhatta Ramesh[1] and Saikia Prasanta Kumar[2]
[1] Ecology & Wildlife biology Lab. Department of Zoology, Gauhati University, Guwahati, Assam
[2] Department of Zoology, Gauhati University, Guwahati, Assam

ABSTRACT

Individual identification of rhinos by observing different identification features combined with photographic evidences technique have been used for sighting and to identify each independent greater one-horned rhinos (*Rhinoceros unicornis*) in Pobitora Wildlife Sanctuary, Assam, India. Identification features were recorded and used to make a Rhino Reference Card by including all the key characters and photographs of different angles showing the identifying characteristics. These features were organized in a searchable database by individual code for each independent rhino. The database and the standard method of describing each rhino will be useful for frontline staff to identify individuals accurately for calculating minimum population, demography, and change in minimum population size. The present study concluded with a basic database of 62 adult (independent) individual rhinos with photographic evidence and also recorded presence of 15 dependent calves (attached to mother). The minimum population in the sanctuary was estimated to be74, deducting three deaths during the study period.

Keywords: Minimum population, Rhino, Pobitora, Rhino reference card.

Pobitora Wildlife Sanctuary is situated in the south bank flood plains of river Brahmaputra at a distance of about 50 kilometers East from Guwahati, the capital city of Assam in the Northeastern part of India.The Sanctuary is small in extent but very rich in biological diversity and is situated in one of the most important biodiversity hotspots of the world. It is home to a large number of birds, amphibian, reptiles and fish species in addition to the Great Indian one-horned Rhinoceros, Asiatic Water Buffalo, Wild Boar, Leopard, Jungle cat, and Jackal. (Baruah and Talukder, 2006). Presently, the Pobitora Wildlife sanctuary is the home for more than 80 Greater one-horned Rhinoceros (Department of Environment and Forest, census report, 2009, Government of Assam, India), having the highest ecological density of the species across the globe and the population is increasing (Talukdar, 1999). The present population has faced critical conservation threats including human disturbance within the sanctuary, excessive cattle grazing, and illegal poaching of the species (Menon, 1996). Moreover, a major cause of concern is that, most of the Rhinos move towards the surrounding human habitations and agricultural areas during night and returned back to the Sanctuary at dawn (Talukdar, 2000). The census of Greater One-horned Rhinceros is practiced in the sanctuary using total counts every 5 years (Foose *et al.*, 1993), which is the only measure for monitoring this species to ascertain its population growth and other parameters (Mukharjee *et al.*, 1999).

The objective of the present study was to develop a basic database of each individual Rhinos with photographic evidences to make the best estimate of the minimum recent Rhino population in the sanctuary. This included formulation of Rhino ID cards for each individual animal which could be useful for daily monitoring of the activities of the species in the Protected Area.

Author for correspondence
Bhatta Ramesh
Email: rbhatta6@gmail.com

Study area

The Pobitora Wildlife Sanctuary covers 38.81 km^2 and lies between the latitude of 26º12$^/$N - 26º16$^/$ 48$^{//}$ N and 91º58$^/$48$^{//}$ - 92º05$^/$24$^{//}$ East longitude (Bora, 2003). The sanctuary is primarily an alluvial floodplain and prone to annual heavy floods with undulating topography comprising a number of small Hillocks scattered along the boundary. The altitude of the area varies from 40-350 meters (Choudhury, 1985). The sanctuary possesses a good network of wetlands and many of these are perennial and thus very favored habitat for various biota (see figure-1). The vegetation of the sanctuary has classified into four distinct forest types viz., Eastern alluvial grassland, Low alluvial savannah woodland, Barringtonia swamp forest, and Northern moist mixed deciduous forest (Bora and Kumar, 2003). The soil is mostly alluvial deposits of rivers (fertile clayey loam) in the low-lying area and rocky for the Hillock.The climate of Pobitora Wildlife Sanctuary is sub-tropical monsoon with four distinct seasons including Winter (Dec.– Feb.), Pre-monsoon (Mar.– May) Monsoon (June-Sept.) and Re-treating monsoon (Oct.-Nov.). Maximum and minimum temperature of the year ranges from 9ºc to 35ºC and average annual rainfall is approximately 2000 mm (Bora, 2003; Bora and Kumar, 2003). The genesis of the sanctuary is very interesting, before independence of India, this area was recognized as a Village Grazing Reserve (VGR) and Professional Grazing Reserve (PGR). With initiative from local people in 1971, the Government of Assam has designated the area as Pobitora Reserve Forest (Govt. Notification No. 4/Settlement/542/65, dated 18.11.1971).

During 1987, the Government of Assam declared the Pobitora Reserve Forest as a Wildlife Sanctuary combining two Reserve Forests, namely Pobitora RF and Rajamayang RF through Govt. Notification No. FNP/19/87/39. Again, during 1998, Government of Assam extended the Sanctuary boundary by adding two new areas, Dubaritali and Kamarpur, to establish an effective corridor between the Pobitora RF and Rajamayang RF for safe passage of animals during high flood (Bora, 2003) through the notification No. FRS.19/87/152.
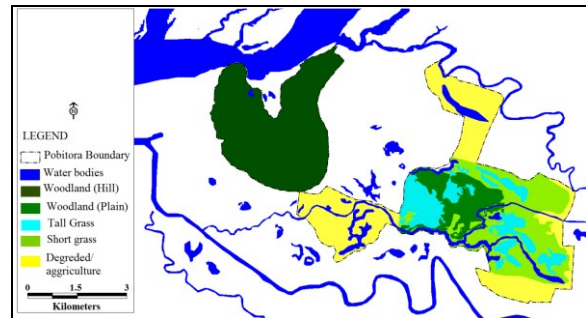

Figure 1. Map of Pobitora Wildlife Sanctuary.

Methods

The study was carried out from September 2007 through August 2009. Direct observation (Laurie, 1978) and photographic techniques (Patton and Martin, 2007) were used for identification of Rhinos based on distinct morphological characters in their external body (Blanford and Price, 1991) including arrangement of skin folds, irregularities in folds, size of the animal, length, signs of permanent injury, horn-length, horn-shape, curvature, rings and horn grooves, tail-length, tail-bands, tail-irregularities, and loss of parts of the tail. Ear-size, ear-shape, ear acquired nicks, presence or absence of hair on the ear were also used to identify individual animals. Permanent cut marks (Hazarika, 2007), white patches, other irregularity on the skin, overall body size and sex (Dinerstein, 1991), and arrangement of tubercles on the rump were also used to identify the individual Rhinos from the rest during Rhino reference card data collection. To cover the entire sanctuary uniformly and to avoid biasness, the entire study area was divided into 1´´ interval grids and each grid was searched preferably in diagonal transect to sight rhinos.

Rhino searching efforts were made in both day and night time using elephant back (Dinerstein and Price, 1991), on foot, using vehicles, and using traditional country boat (non mechanized) depending on seasons and existing terrain. A high resolution binocular (Nikon, 10×40) was used for observation of body characters (Lauri, 1974). A Sony Digital Camera (8.0 Mega Pixel, 15X optical & 40× Digital Zoom) with a Tele-Conversion Lens (1.7× Zoom) was used to obtained photographs and videos. Night hour photographs were taken using high beam search light. Photographs and videos were transferred to an IBM laptop in each day and observed carefully for existing identifying characters. After careful observation of the photographs, important photographs were coded

and arranged for each individual Rhinos (Patton, 2007). Observations in every sighting of individual recorded in a pre-designed field format with required sketch of the animal and continuously attempted to up-date several identifying features from every angle with photographic evidences to reduce the possibility of two Rhinos with same recorded characters (Lauri, 1978). The collected information along with the code of identifying photographs was continuously feed to Microsoft Access database. Using all observed characters and the photographic evidence, a "**Rhino Reference Card**" was generated for each individual Rhinos to make it quick and immediate spot identification of Rhinos. In this way the database was build up and minimum population demography of Greater One-horned Rhinoceros for Pobitora Wildlilife Sanctuary was determined. Reference Card for dependent calves (individuals) that was attached to the mother was not prepared separately but incorporated them referring mother's identity.

Results

Altogether 2779 rhino have been sightings during entire study period, of which, 1057 were complete sighting individuals and 1722 were incomplete sighting individuals (Figure 2). The Rhino Reference Cards have been developed in each independent Rhinos based on direct observation and analysis of individual characters and obtained photographs (Figure 5). The new sighting records of rhino has been increased gradually from the months of September 2007 (first field trip) and continued till the months of October-November, 2007 and December- January, 2007-2008 (2nd and 3rd field trip) (Figure 3). However, the new sighting records have been drastically declined afterwards and no new sightings was found in last three field visits (December-February, 2008-2009; April-May, 2009 and June-August, 2009) (Figure 3). Owing to the small area covered in the Sanctuary, isolated habitat and as well as high visibility, almost all Rhinos have been recorded during first year survey. There was single new sighting during early part of the proceeding year field survey. The highest number of Rhino re-sighting was made during December-February, 2008-2009 and gradually it was increased till end of the survey (Figure 4).
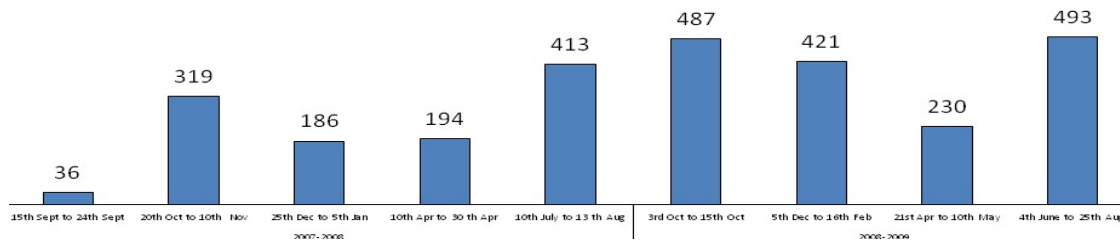

Figure 2. Total sighting records of Rhinos in different field days at Pobitora Wildlife Sanctuary.
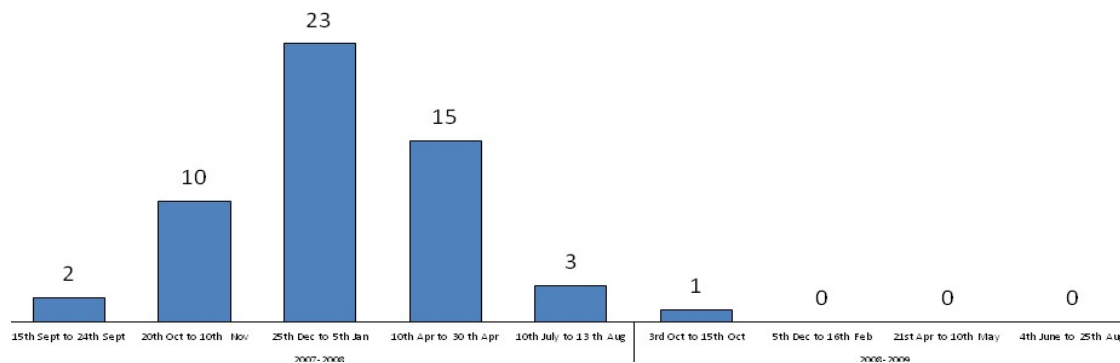

Figure 3. Sighting records of new individuals of Rhino in study site in each field visit.
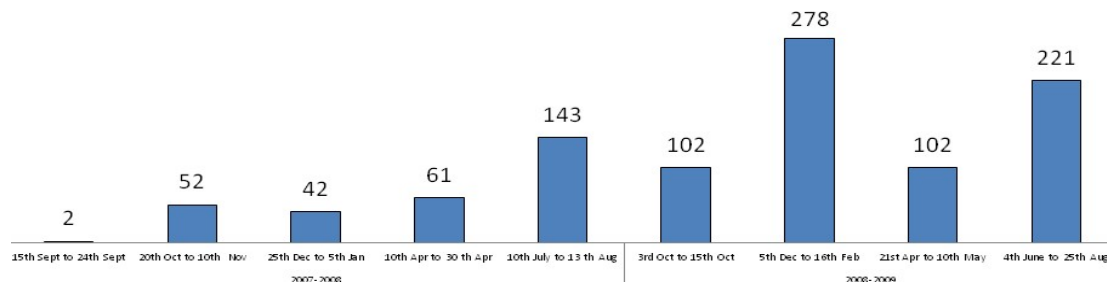
Figure 4. Re-sighting records of individual Rhinos in study site in each field visit.

The Collection of Rhino Reference Card suggested that there were altogether 74 rhinos in Pobitora Wildlife Sanctuary. Of which 59 were independently moving adult and sub-adult and 15 were dependent calf (that attached with mother) (Table 1). The concluding minimum population demography during survey was 29% adult female (22 numbers), 21% adult male (16 numbers), 10% sub-adult female (8 numbers), 10% sub-adult male (8 numbers), 10% male calf (8 numbers), 7% female calf (5 numbers) and 13% calf (10 numbers, sex could not be determined). Altogether 12 rhinos have been died during study period owing to natural cause, of which 3 were previously marked and documented (M30, M31 & M32) in Rhino Reference Card and others

were not documented. The detail of individual Rhino's- code, key identifying characters, age, sex and calf position have been shown in Table 2.

Table 1. Numbers of Rhinos recorded in different age and sex classes at Pobitora Wildlife sanctuary

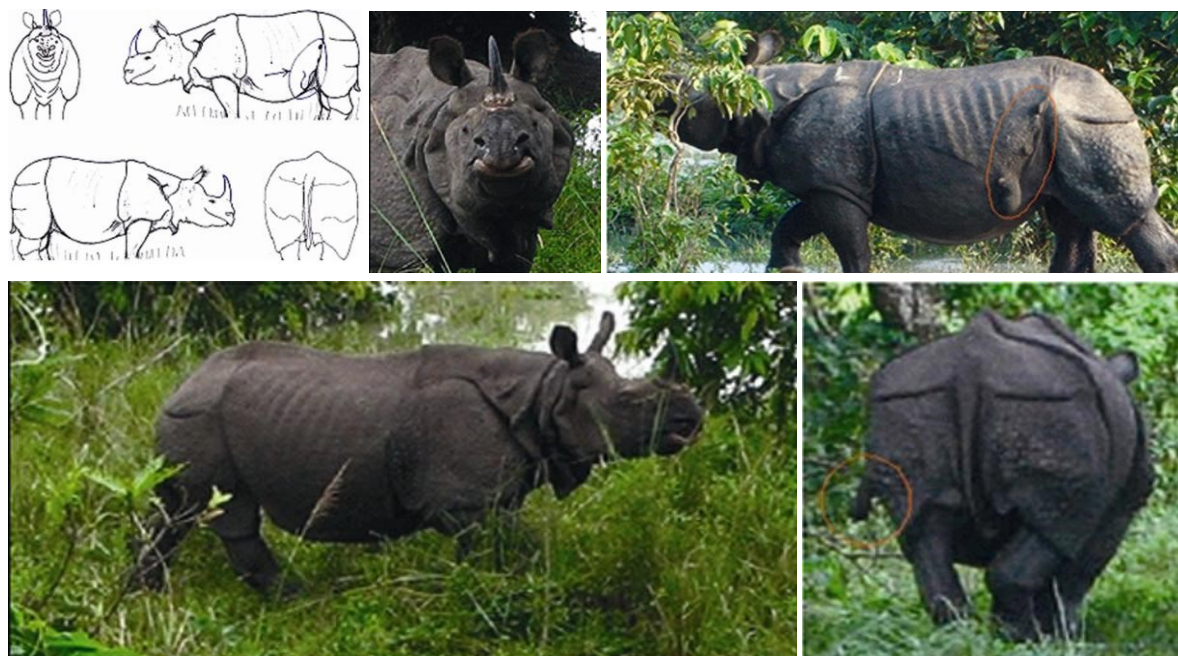| Age Class	Total Numbers sighted
Adult Female	22
Adult Male	16
Sub-Adult Male	8
Sub-adult Female	8
Male Calf	8
Female Calf	5
Un sexed calf	10
Death occurred rhino of adult during study	-3
Total	74

Figure 5. Representative Rhino Reference Card developed at Pobitora Wildlife Sanctuary after extensive field survey.
Key Identity- Lumpy out growth in the lower left abdomen; Horn-Elongated slightly bend backward and more than 10 inch in length; Ear-Ears are clean and short hair present; Skin Folds- RLXF possess two small outgrowth in the middle and a bigger out growth seen in the lower abdomen; Tail-Tail is normal smooth and elongated.

Table 2. Greater One-horned Rhinoceros demography in Pobitora Wildlife Sanctuary, 2009 (RRXF: Rear right cross fold; RLXF: Rear left cross fold; URCF: upper right corner fold; ULCF: upper left corner fold; LLCF: lower left corner fold; LRCF: lower right corner fold; M: male; F: Female; U: unconfirmed sex; A: adult; SA: sub adult; *: Rhino died during the study period).

Sl. No.	Ref. No.	sex	Age	Identifying Characters	Dependent-Calf		
					No	sex	Age
1	M01	M	A	Lumpy outgrowth in the lower left abdomen.	-	-	-
2	M02	M	A	Base of the tail is depressed and banned	-	-	-
3	M03	M	A	Left ear possess an acquired nicks	-	-	-
4	M04	M	A	Tip of the horn is broken and URCF is "{" shaped	-	-	-
5	M05	M	A	Left ear is distinctively smaller to the right ear.	-	-	-
6	M06	F	A	RLXF possess a "V" shaped cut mark	1	U	<1
7	M07	M	SA	Tail is elongated and heavy degeneration on the base of the tail	-	-	-
8	M08	F	A	Right ear loss one part, skin possess pink pigmentation	1	F	2 -3
9	M09	F	A	Prominent cut mark on RLXF between ULCF & LLCF	1	U	<2
10	M10	M	A	Horn broken, tail is very short	-	-	-
11	M11	F	A	Horn bend backward and tip of the horn is like fish tail fin	1	F	<1
12	M12	M	A	Possess a very small cut mark at right year	-	-	-
13	M13	F	A	Tip of the horn is bulb like and right year loss one part	1	M	3-4
14	M14	M	A	Left ear is looking like a newly developed ear from the original one that cut at base.	-	-	-
15	M15	M	A	Right ear posses a cut mark also posses pigmentation at neck fold	-	-	-
16	M16	F	A	Base of the tail is bulging and tail is shorter in length	1	M	3-4
17	M17	F	A	Left ear loss one part, RRXF possess one small cut mark between URCF & LRCF	1	U	>1
18	M18	F	A	"V" shaped cut mark in RRXF near URCF	1	F	2-3
19	M19	F	SA	Two prominent cut mark in RRXF	-	-	-
20	M20	M	A	Left ear posses small cut mark, tubercle on left ramp form a line like "L"	-	-	-
21	M21	F	A	V' shaped cut mark in RLXF	1	U	1-2
22	M22	F	A	Tubercle pattern in the right ramp is "J" shaped, tail is shorter and the base oval shaped	1	U	2-3
23	M23	F	A	Folds over the left hind leg posses additional fold, body is large, tail of the calf posses two bands	1	U	<1
24	M24	F	A	Cut mark on RRXF near URCF	1	M	2-3
25	M25	M	A	RLXF possess a cut mark near LLCF	-	-	-
26	M26	M	SA	Tail base is depress and tail posses a band	-	-	-
27	M27	F	A	RLXF possess a cut mark near ULCF	1	U	<1
28	M28	M	SA	RLXF possess a cut mark near ULCF	-	-	-
29	M29	F	SA	RRXF posses a saw like edge near ULCF & LLCF	-	-	-
30	M30	F	A	Tail loss the end part *	1	F	>3
31	M31	F	A	Tail posses zigzag bands*	1	M	<2
32	M32	M	SA	both the ear posses cut mark*	-	-	-
33	C01	F	SA	Horn tip is small blub like, horn body is screw like	-	-	-
34	C02	F	SA	Horn is not developed only the base plate developed	-	-	-
35	C03	M	SA	Horn is short and oval shaped, ear posses long and dense hair.	-	-	-
36	C04	M	A	Horn is elongated approximately 12 inch long, slender and both the ear posses long hair.	-	-	-
37	C05	F	SA	Horn triangular , ear posses thick short hair	-	-	-
38	C06	F	A	Horn is sharp looking like attached on a base plate, a small calf attached	1	U	<2
39	C07	F	SA	Horn is not developed fully 2.5 inch approx, base is thick blunt	-	-	-
40	C08	M	SA	Horn is 3-4 inch approx triangular, band backward, posses a ring on tip, both the ear posses long hair	-	-	-
41	C09	M	SA	Horn triangular, two ring found , ear posses thick short hair from base to tip	-	-	-
42	C10	F	A	Tip of the horn is sharp, pointed 2 inch aprox, a calf of around 2 year of age	1	U	2-3
43	C11	F	A	Horn posses a notch from front side, a male calf attached	1	M	2-3
44	C12	M	A	Horn very long sharp pointed band backwards, ear posses long hair	-	-	-
45	C13	M	A	Very long horn, tip is blunt, ears posses short hair	-	-	-
46	C14	M	SA	Horn not developed , no hair on ear	-	-	-
47	C15	F	A	Short horn, big female calf of 2-3 years of age	1	F	2-3
48	C16	F	A	Short horn, big male calf of >3 years of age	1	M	>3
49	C17	F	A	Short pointed horn with a male calf of 1-2 years of age	1	M	1-2
50	C18	F	A	Horn is elongated slender with number of small rings like structure, attached a male calf of 2 year aprox.	1	M	2-3
51	C19	F	A	Horn elongated on a base plate with an un identified calf of 2-3 years.	1	U	2-3
52	C20	M	A	Horn is 3-4 inch aprox, thick base	-	-	-
53	C21	M	A	Horn is degenerating, ear posses long hair	-	-	-
54	C22	F	SA	Horn not developed , no hair on ear, tail base is thick	-	-	-

Discussion

The skill of individual identification at sight, based on key characters is acquired during present study after rigorous field practices. The authors, with the help of frontline forest staffs expends above one year time period to develop the skill and thus standardized the whole process. Onsite records of characters and photographs from all angles of the animals are found to be very vital for re-verification during spot identification. However, certain key indentifying characters are overlooked during direct observation, but rerecorded photographic evidences in the process has tremendously helps to easy re-verification of post re-sightings individuals. This type of Rhino reference Card study that has been conducted only at Pobitora Wildlife Sanctuary of Assam become more interesting for front line forest staff as they acquired individual identification skill using standard description. Prior to this study, the rhinos were classified on the basis of age, sex and attachment of calf with mother only.

The major conservation concern of Rhino in Pobitora is extensive habitat degradation owing to heavy human pressure in the form of cattle grazing, collection of NTFPs and poaching for horn. In each day, almost 40% Rhinos stray out of the sanctuary (Talukdar, 2003) towards human habitation and

agricultural field in evening and returned to sanctuary at dawn, this situation increases the probability of poaching and disease outbreak. The potential conservation strategy is that, the threats like poaching and disease outbreak could be minimize by a systemic monitoring in each individuals separately with the help of individual ID and planning for conservation measures. Again, the monitoring of population size at individual level is one of the prime requisite for a true sense of meta-population management (Jnawali, 1995). Thus the present study of population demography based on rhino reference card is appropriate in the present context.

Acknowledgement

References

Blanford, W.T. 1991. Sexual dimorphism in One-horned Rhinoceros. *Journal of Mammals* 72: 450-457.

Blanford, W.T. and Price, L. 1991. Demography and habitat use by Greater one-horn Rhinoceros in Nepal. *Journal of Wildlife Management* 55: 401-411.

Bora, C. K. 2003. Management Action Plane of Pobitora Wildlife Sanctuary, Dept. Env. & forest Govt. of Assam. 127Pp.

Bora, P.J. and Kumar, Y. 2003. Floristic Diversity of Assam, Study of Pobitora Wildlife Sanctuary. Daya Publishing house, New Delhi. 488Pp.

Choudhury, A.U. 1985. Distribution of Indian one-horned Rhinoceros. *Tiger paper* XII (2): 25-30.

Choudhury, A.U. 1989. Pabitora, Assam's Rhino reserve. *The India Magazine* 9: 46-54.

Dinerstein, E. 1991. Sexual dimorphism in the Greater One-horned Rhinoceros (*Rhinoceros unicornis*). *Journal of Mammals 72(3): 450-457.*

Dinerstein, E. and Price, L. 1991. Demography and Habitat used by Greater One Horned Rhinoceros in Nepal. *Journal of Wildlife Management 55(3): 401-411.*

Foose, T., Moulur, S. and Walker, S. 1993. Briefing material on Population and habitat viability analysis workshop for Indian/Nepali Rhinoceros. *Asian Rhino Specialiest Group, Zoo outreach organization /CBSG*:307Pp.

Hazrika, B.C. 2007. Studies on the Eco-Behavioural Aspects of Great Indian One-Horned Rhino (*Rhinoceros unicornis* Lin.) in Orang National Park, India. *Ph. D. Thesis, Gauhati University.* 174Pp.

Jnawali, S.R. 1995. Population Ecology of Greater One Horned Rhinoceros (*Rhinoceros unicornis*) with Particular Emphasis on Habitat Preference, Food Ecology and Ranging Behaviouir of a Reintroduced Population in Royal Bordia National Park in Lowland Nepal. *Ph. D. thesis Agricultural University of Norway, Oslo, Norway.*129Pp.

Laurie, W. A. 1978. The Ecology and Behaviour Of the Greater One-Horned Rhinoceros. *Ph.D. Dissertation, Cambridge University.* 486Pp.

Menon, V. 1996. Under siege: Poaching and protection of greater one-horn Rhinoceros in India. *TRAFFIC India.*

Mukharjee, S., and Sengupta, S. 1999. Census of Great Indian One Horned Rhinoceros at Jaldapara Wildlife Sanctuary, Cooch Behar Forest division, West Bengal, India. *Tiger Paper* 26(4).

Patton, F.J., and Martin, J. 2007. Determining Minimum Population Size and Demographics of Black Rhinos in Salient of Aberdare National Park, Kenya. *Pachyderm* 43: 63-73.

Patton, F.J. 2007. The use of individual identification in the conservation management of black rhinoceros (*Diceros bicornis*). PhD thesis, Manchester Metropolitan University,UK. 218 Pp.

Talukdar, B.K. 1999. Status of *Rhinoceros unicornis* in Pabitoa Wildlife Sanctuary, Assam, India. *Tiger Paper* 26.

Talukdar, B.K. 2000. The current status of Rhino in Assam and threats in 21st century. *Pachyderm* 29: 39-47.

Talukdar, B.K., and Baruah, M. 2006. Wonders of Pobitora, Aaranyak. 56p.

NeBIO