MANAGEMENT OF THE REINTRODUCED GREAT ONE HORNED RHINOCEROS (*RHINOCEROS UNICORNIS*) IN DUDHWA NATIONAL PARK UTTAR PRADESH, INDIA

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INTRODUCTION

Once widely distributed in the Uttar Pradesh terai, the great one horned rhino was fighting a losing battle for survival by the turn of the 19th century. Initially, primarily due to over hunting and later due to fragmentation of its habitat due to disparate land uses such as agriculture, reclamation of swamps for growing human habitations, rampant grazing of domestic livestock and uncontrolled fires. The last rhino was shot in Pilibhit district in proximity of the now Dudhwa national park in 1878. These causes which were common to terai, eliminated the rhino from most of its former range of distribution which once stretched from the foot of Hindukush range to Burma along the low lying flood plains. At present the rhino population is restricted to seven reserves in Assam and West Bengal in India and the Royal Chitwan N.P., Nepal. Two major existing rhino populations are in Kaziranga N.P. (1080), Assam and Royal Chitwan N.P. (375), Nepal (Action plan: Asian Rhino Specialist Group, 1989). Remaining rhino populations with the exception of Manas (707 sq km) and Orang (92 sq km) are surviving in small and insecure pockets with a doubtful future. This includes a population of about 60 rhinos in Pobitara, Assam which represents the highest density of rhinos, wandering widely in surrounding agricultural areas but depending on the 16 sq km area of the sanctuary for security. In spite of the protective measures, persecution of this animal continues with the exceptionally high and illegal price on the rhino horn in clandestine market. In Kaziranga, N.P. between 1983-89, a total of 603 rhinos were lost to poaching and mortality due to floods, disease and old age. Out of these 235 rhinos were killed by the poachers alone for horns (Dutta, 1990). Earlier between 1965-71, only 63 poaching cases were reported. Later years show a spurt in poaching cases. During the first two months of 1990, 16 rhinos were killed by poachers. The entire population of rhino in the Laokhowa Sanctuary has been wiped out in recent memory. In Jaldapara Sanctuary the rhino population has been reduced from 80 animals to 30 between 1970 to 1990 due to poaching. Poaching cases are also reported from the Royal Chitwan N.P. in spite of extremely strong protection measures (Dutta 1990). These examples are illustrative of the odds faced by rhinos and field managers. There is no lack of will or effort on the part of the managers but the preparedness of poachers, their shrewd organized efforts and backing of logistics and finance far outweigh the efforts and support the managers can muster.

The reintroduction of a species in its former range of distribution, with all factors in favour, is an accepted practice in wildlife management, especially relevant in context of species like the rhino, which is habitat specific and has a restricted range of distribution now. The first experiment of reintroduction of the great Indian one horned rhino into Dudhwa N.P. Uttar Pradesh (U.P.) was taken up in India in 1984 and is described by Samar Singh and Rao (1984). There were initial setbacks with the loss of 2 cows out of the nucleus of 2 males and 3 cows taken from Assam. One died due to stress- induced abortion and the other due to an injury. A further batch of 4 female rhinos were translocated from Nepal and rehabilitated in the reintroduction area of 25 sq km of Dudhwa N.P. (RRA) during 1985 without incident. Later during the year 1988, the two bulls continually fought, were time and again injured and as a result the dominated bull had to be separated from the population and released in a specially prepared 4 sq km power fence enclosure. After several months he died because of hemorrhagic septicemia. In 1987 the first evidence of breeding was noticed, unfortunately through a carcass of a newly born calf. The actual cause of death could not be established as it was too late to do so by the time the carcass was discovered. During 1989, 4 calves were born to 4 females. One of the calves, a male, died of pneumonia in January 1990, after

attaining the age of 1 month, 15 days. Though such mortality is normal in the wild, it amounted to a serious loss in the translocated small population.

The present re-introduced rhino population of 9, comprised of 5 adult cows, 1 bull and 3 calves in the RRA is too small to absorb the normally acting mortality factors, though the state of their health and breeding is indeed very encouraging.

THE RHINO REINTRODUCTION PROGRAMME IN INDIA

The I.U.C.N. Asian Rhino Specialist Group and Rhino subcommittee of Indian Board for Wildlife recommended the establishment of an additional rhino population in order to improve the conservation status of the species, (Sale, 1981). Population estimates of the great one horned rhino, as in 1989 appear at Table 1.

Table 1 Population estimate of the Great Indian Onehorned Rhinoceros 1989

S.No	Country	Location	No of Rhino	Habitat availability		Protection Status	Potential Carrying Capacity
				Present (km-2)	Potentially (km-2)		
1.	Bhutan/India	Manas	60	391	391	WLS	> 100
2.	India	Dudhwa	7(9)	490	490	N.P.	> 100
3.	India	Kaziranga	1080	430	430	N.P.	>1080
4.	India	Laokhowa	5	70	70	WLS	> (?)
5	India	Orang	65	76	76	WLS	> 100
6.	India	Pobitara	40	16	16	WLS	> 40
7.	India	Pockets in Assam	25	(?)	(?)	Insecure	(?)
8.	India	Pockets in W.B	32	(?)	(?)	Insecure	(?)
9.	Nepal	Royal Bardia	13	968	968	WLR	> 400
10.	Nepal	Royal Chitwan	375	92	1200	N.P.	>400
11	Pakistan	Lal sohanra	?	?	?	N.P.	?
		TOTAL	1,724				2,200

Source: Action Plan: Asian Rhino Specialist Group (1989).

Several potential sites were surveyed by a panel of experts. The choice for reintroduction was in favour of Dudhwa N.P. (490 sq km) in U.P. The park is a part of the former range of rhino distribution and had the necessary habitat attributes, extent of area and security for the animals, all critical requirements for re-introduction of an endangered species.

An area of 90 sq km was selected on the basis of suitability of habitat in the south Sonaripur and south Belrain ranges. It was also proposed to translocate in all 30 rhinos in a period of 5 years after the release of the first batch of rhinos. Finally in 1984, and area of

25 sq km in the Kakraha black was enclosed by a 3 strand power fence within which the first batch of rhinos were released.

THE TRANSLOCATION OPERATION

In 1984, five rhinos, comprised of 2 males and 3 females, were captured, crated and translocated from around Pobitara sanctuary, Assam, flown to Delhi in a specially chartered Aeroflot cargo plane, off-loaded and then transported to Dudhwa in trucks by road, 400 km, in 11 hrs. During the translocation operation 2 cows died, one due to stressful abortion. The other was immobilized after reaching Dudhwa for care of injuries sustained. But it did not recover and died. After having reached Dudhwa, the rhinos were first released in a specially constructed stockade for health care before their final release into the RRA. Each rhino had a separate section to itself. After several days they were released. The dominant male was provided a radio collar to monitor its movement. A separate component of staff was appointed to manage the RRA and monitor the rhinos on daily basis. Riding elephants were deployed for the purpose. Entry of other than managers was barred. A second batch of 4 female rhinos were captured in the wild in Nepal by Wildlife department personnel and transported in trucks to Dudhwa and released in the RRA during 1985. The current status of the population has already been described.

MONITORING REHABILITATION OF RE-INTRODUCED RHINOS

In 1987, a project to study the rehabilitation process of the rhinos was taken up which included habitat utilization patterns, inter and intra specific behaviour, and monitoring the state of health. The Wildlife Institute of India and the forest department of U.P. are partners in the project. Apart from investigations, the project handled all aspects of management of the RRA.

THE STUDY AREA

The Dudhwa National Park, a part of the Dudwa tiger reserve since 1987, is in the Kheri district of Uttar Pradesh (UP) and lies between 28 18'N and 28 42'N latitudes and 80 28' E and 80 57' E longitudes, approximately 30 km south of the Nepal Himalayas. It is 490 sq km in extent. It has a buffer zone of 124 sq km under the control of the Park administration.

The park is a compact block of approximately 50 km in length by 10 km in width. The Mohana and Suheli rivers constitute respectively the northern and the southern boundaries. An area of 25 sq km within Kakhraha block surrounded by a power fence constitutes the RRA. A section of the fence perimeter has a parallel stretch of trench. The RRA habitat is a mix of tall wet grassland woodland complex with ten perennial swamps. South of the RRA flows the river Suheli.

VEGETATION

The high land in terai is occupied by woodland dominated by sal (*Shorea robusta*). The seasonally flooded low land interspersed with swamps supports tall grass communities with occasional patches of riparian woodland principally represented by *Syzygium cuminii*. The drier portions of grassland has relatively short grasses and scattered trees of *Acacia catechu*, *Bombax ceiba* and *Dalbergia sissoo* called as fringe forest. Though plantations of species such as *Acacia catechu*, *Bombax ceiba*, *Dalbergia sissoo*, *Tectona grandis* and Eucalyptus ssp are raised in terai to the detriment of grasslands and grassland dependent wildlife, the RRA does not contain any plantation. Indeed all the potential rhino habitat is free of man made woodlands. Earlier till about 1975, particularly in Kakhraha block, part of which is now the RRA, used to have heavy grazing of domestic buffalo and some permanent cattle camps.

Residents of villages around the block were allowed to extract fuelwood and thatch grass from this area. All of this was stopped since 1975. The grasslands recovered rapidly along with this the population of about 40 black buck (*Antilope cervicapra*) and nilgai (*Boselaphus tragocamelus*) disappeared. There has been a remarkable increase of swamp deer (*Cervus duvauceli duvauceli*) from few in 1975 to approx. 450 in 1991 mainly as a consequence of immigration into a high quality habitat.
From vegetation point of view the RRA is classified in to 6 major vegetation types used by rhino as indicated in Table-2.

Table 2. Constitution of RRA by vegetation types.

S.No.	Vegetation Type	Area in hectares
1	Tall Grassland	343.0
2	Short Grassland	807.0
3	Marshy Grassland	563.0
4	Water bodies	107.0
5	Fringes & Riparian	107.0
6	Woodland	584.0

The key species of vegetation associated within each type are as follows:

1. Tall grassland: *Erianthus Spp, Saccharum spp, Imperata cylindrica, Hemarthria compressa, Desmostachya bipinnata, Vetiveria zizynoides, Cyperus spp, Sclerostycha fusca.*
2. Short grassland: *Saccharum spontaneum, S. bengalensis, Narenga porphyrocoma, Apluda mutica.*
3. Marshy grassland: *Sclerostycha fusca, Arundo donax, Phragmites karka, Themeda arundineria, Hemarthria compressa, Carex spp.*
4. Water Bodies: *Trappa spp, Nymphacea spp, Hygrorhyza cristata, Hydrilla, Vallesnaria, Nelumbo.*
5. Fringes and Riparian habitat: *Accacia catechu, Bombax ceiba, Dalbergia sissoo, Butea monosporma, Syzygium cuminil (Riparian)*
6. Woodland forest: *Shorea robusta*, (dominant species and associates.)

METHODOLOGY

RHINO MONITORING

All the adult rhinoceros were identified by their prominent features. Each rhino bears a name derived from either a river or mountain thus Banke the existing male, Rapti, Narayani, Swayamvara, Himrani and Pavitri the females. The calves have not been named. All adult rhinos with identifying features are photographed.

Every day four riding elephants were used to locate all the rhinos. Seldom were all the rhinos sighted everyday due to poor sighting conditions except for a short post burn period before summer. Rhinos were also sighted on foot, using motorcycle and from atop machans (observation platforms). Rhinos were observed between sunrise and sunset, the time depending on season. Each location of Rhino was recorded on a map of RRA indicating vegetation classification superimposed by a grid. Each grid cell on the ground was 100 x 100 meters.

To identify individual rhinos the scheme of Laurie (1978) which uses different physical traits, such as: arrangement of the tubercles on the rump, nicks on the ear, length of tail, length of horn and shape, was used. Table 3 exhibits identification features for each of the adult rhinos.

Table 3. Identification features of adult rhinos in RRA

S.No.	Name	Physical trait of rhino				
		Collar folds	Horn shape & size	Shape of pigment patch	Ear nicks	Other characteristic features
1.	Banke M	Massive	Long with deep furrow	-	-	-
2.	Pavitri F	-	Small & pointed	square patch of pigment	-	-
3.	Himrani F	-	Nothing special	small and rounded	left ear with hole	left ear folded
	Calf F	-	-	-	Right ear is bifur-cated from tip.	-
4.	Narayani F	-	-	2 ring shape	-	Aggressive
	Calf F	-	-	-	-	-
5.	Rapti F	-	short with broken tip	-	-	-
	Calf F	Prominent Folds				
6.	Swayamvara F	-	sharp and pointed tip	-	-	Longest tail among all the cows . Right flank has deep wound scar

M - male F - Female

HABITAT STUDY

A detailed study of habitat was conducted from elephant back and on foot. After initial survey a 100 x 100 m grid to scale was superimposed on map. These grid and constituents were identified on the basis of physical and vegetation characteristics and ranging. Markers in the field were identified. Grids were used in all subsequent observations. All water bodies and prominent patches of dominant grass communities and types classified were demarcated on a grid map. Range finder was used to assess dimensions of different vegetation types and physically verified.

For studies involving quantification, in each vegetation type randomly 10 circular plots of 2m diameter were laid and following data pertaining to vegetation was gathered: (i)

dominant species (ii) top height of associates (iii) estimation of biomass (Oven dry) (iv) soil texture and type samples were collected, for analysis (v) soil moisture at different depths 5, 10, 20 cms. (vi) plants/grass species eaten by rhino and other herbivores observed (vii) height at which vegetation cropped (viii) aquatic plants eaten by rhino and other herbivores were recorded and cropped for biomass estimation.

HABITAT USE

To identify areas of various levels of activity of rhinos in RRA in different seasons, the observed values were gathered in Harmonic Mean Transformation Polygon (HMTP) using Mcpaal programme (Dixan and Chapman, 1980). Based on 90-50% of the sighting in different seasons, area of maximum use was established.

This study established that in the RRA rhinos used 55 different plant species, belonging to 25 families, as food. This included grasses (23), aquatic plants (9) tree species (12), woody climbers (5), herbs and shrubs (5), and one species of fern..

. The diet of rhinos in winter consisted of 35 species of plants of which grasses constituted 48%, aquatic plants 18% and 44% of the diet consisted of woody plants.

Towards the end of winter most grass species attain full maturity and start dying except those in the marshy areas. During this period rhinos feed considerably on aquatic and woody plants. The water level in most water bodies starts receding. This process is more visible in seasonal swamps. Aquatic plants become more accessible. Ferns and the bark of *Acacia catechu* are also eaten. During winter, rhinos seek thermal cover in woodland and stay within woodland till late morning hours.

Between February and March most of the grassland within RRA is burned. During this period rhinos feed on *Teliacora acuminata* a climber and leaves and twigs of *Mallotus phillippinensis*. Around tals (water bodies) they feed on *Cynodon dactylon, Hygrorhyza cristata, Trappa* and *Vallesnaria*. Within 2-3 days of burning rhinos start feeding on burned swards of tall grasses and also lick ash on the ground.

Rhinos feed on the tips of young shoots, leaves, stems and thin woody branchlets. Complete inflorescence and flowers were also eaten. *Cynodon dactylon* and *Hygrorhyza cristata* were uprooted and fully eaten. The portions of plants eaten varied between 37%-79% of the whole plants depending upon the plant size and species.

Some wild rice (*Oryza sp*) is present around swamps in RRA. This is present elsewhere in Dudwa and native to the habitat. It was introduced in suitable areas of the swamp complex within RRA during 1989. Similarly, the native aquatic plants such as Trappa, Nymphacea were also artificially propagated. These are now well established and used as food by rhino.

By adopting the Neu, *et. al.*, (1974) statistical technique, the preference in terms of percentage of area of a particular habitat used in relation to the total habitat types existing the RRA was estimated. Table 4 summarizes the preference for selected habitats in different seasons. Aquatic habitat were used by the rhinos in all the seasons but in summer it was used more in relation to the area available during this season. Marshy grasslands exhibited similar pattern. Tall grassland was equally used in monsoon and winter months while in monsoon, the woodland areas were also used. 32% of the RRA is occupied by short grassland which mostly falls to the southern side within the RRA. This was hardly used by the rhino. The main reason was the absence of water bodies. On the other hand this area was occupied by 485 swamp deer and approximately 200 hog deer. Other herbivores found in the RRA were the spotted deer, wild pig, barking deer, sambar, hispid hare and a herd of 35-40 wild elephants visited the RRA every year.

SPATIAL USE PATTERN

By using harmonic mean transformation polygons, the area of maximum use at 50%-90% level was calculated separately for different seasons. It was found that during summer only 40.76% of the RRA was used by females and calves. During the monsoon and winter, the percentage area of RRA used was respectively 35.64% and 29.00%. There was variation between 10.19 to 4.16 sq km in summer, in monsoon between 6.41 to 2.08 sq km and in winter between 7.25 to 1.95 sq km (90-50 HMT level) while in case of the lone male the percentage of area used in different seasons varied from 36.36% to 47.80%. The area used by this male in different seasons varied from 2.50 -11.95 sq km.

MONITORING OF TIGER MOVEMENT INSIDE AND OUTSIDE THE RHINO REINTRODUCTION AREA (RRA):

The RRA is a prime tiger habitat. Tigers were considered as a potential threat to rhino calves. Tiger movements were regularly monitored and recorded through tracks and sightings (Figure 3). Location of scats was recorded and information was gathered about kills. Skulls and jaw bones of killed prey were collected and scats were analyzed to obtain a picture of predation.

The study indicated that three male tigers had overlapping home ranges along with those of two females. On three occasions a tiger was sighted within 100 meters of a rhino cow and calf. On one occasion a tiger chased a rhino cow and calf but the presence of some patrolling staff distracted the tiger which was made to leave the spot with the help of a riding elephant. In all probability this was not a serious interaction. In 1988, the three strand power fence surrounding the RRA was replaced by a 2.70m tall seven strand fence to obstruct free access of tigers to RRA. The fence did not prove to be a barrier for movement of tigers. The calves by now are presumably past the serious predation threat posed by tigers.

MONITORING HEALTH CONDITION

Every day the located rhinos were scrutinized for wounds or fresh scars. In the event of a noticed injury the local veterinary officer was usually called and the prescribed medicine was applied by spraying with the help of a modified pump. Dung samples were collected to estimate parasitic load. Nothing abnormal has come to notice. During January 1990 one of the four rhino calves died, as has already been mentioned, due to pneumonia.

MAINTENANCE OF POWER FENCE

On 2nd February 1989, the first rhino calf was sighted in RRA. Strict vigil was maintained over rhino cow and calf to discourage the odd tiger. An area of 2.5 sq km was enclosed by a 3 strand power fence. Two observation huts were constructed and 10 persons were recruited to keep vigil over the cow and calf within the mini fence. This arrangement continued for almost 9 months. Similar measures could not be taken for calves born later due to practical reasons but there was no relaxation in vigilance. The power fence was checked regularly for any defects along its entire length, current flow was monitored every day. Sometimes for compelling reasons the fence for some time remained non-functional but continued to act as an effective barrier for rhinos. The power fence initially used a single S.B. model, Gallagher, New Zealand made energiser working on 12/24 volt battery power at pulse rate of 50 pulses per minute for the 3 strand power fence meant to confine the rhinos within the RRA. Later to minimize the possible threat of calf predation by tigers this fence was replaced by a 2.7 meter high, seven strand fence. Two energizers powered the fence, with four wires energized and 3 used as earthing. The fence runs over 18 km. However, tigers have been successfully negotiating it but so far have not posed any problems.

During monsoon months, from June to October, because of floods and inaccessibility by road the regular supply of charged batteries from park headquarters to two different

locations of the energisers was hampered. In some of the fence sections up to 3 of the lower strands can get submerged making the fence inoperable temporarily.

Migratory elephant herds regularly travel between Suklaphanta (Nepal) to Dudwa and beyond. Between 1986 to 1988 elephant herds entered the park and were seen around the RRA. Occasionally they have broken a section of the fence to get inside the RRA. This proved a trying time in the matter of maintaining the fence. Fortunately elephants have not stayed around the area for any length of time of any serious consequence so far.

There has been only one instance when any rhino has breached the fence. This was during June 1988 when the two rhino males had serious fights. However, on separating the dominant male the problem stopped.

During monsoon, currents of flood waters do cause collapse of sections of the fence. The ground is sandy and has little binding capability. Rust on wires and rot in poles are routine problems. On a couple of occasions theft of wire from the power fence was detected. These are some of the common problems in maintaining the power fence. But there is nothing that cannot be managed.

FUTURE OF THE RE-INTRODUCED POPULATION

The findings of the project indicate that the re-introduced population is well established within the RRA. The management has provided the required security. The population is however too small to withstand natural random events. How many more rhinos can the RRA accommodate is a moot question. There is no practical way to establish such limit, however in consideration to densities observed in the wild in prime habitats it would be safe to make a statement that several more rhinos can be accommodated within the RRA. The present RRA, delimited by the power fence is not an end in itself. The remaining contiguous suitable rhino habitat needs to be brought under specific management in context of future addition to the population through translocations, which is the only way to ensure the viability of this venture. A detailed survey of the unused potential rhino habitat is necessary to assess management requirements of the grassland-swamp-woodland habitat so also the implications of additional man power and logistical support for it to function efficiently needs to be determined. A self-contained management plan is essential. The chota Kakraha, Churela and Bhadital areas are most promising. These also are prime tiger habitats. The overall size of the re-introduced population needs to be large enough to withstand all natural impacts not to mention genetic viability . The southern boundary along the potential rhino habitat will in all probability need a power fence to preclude rhino movement across the Suheli river into the sugar cane and paddy fields lying south of it. The park management already faces a serious problem of man killing by tigers though not necessarily by tigers from within the park. But such a problem is naturally and eminently related to park management. There is a grave risk of aggravating the existing confrontation with people by the possibility of straying rhinos in future. Appropriate measures therefore first need to be planned before further steps are taken for enlarging the reintroduction area beyond the present RRA. The most critical factor is support to management in providing the requisite capability. The highly endangered northern swamp deer (*Cervus duvauceli duvauceli*) is also likely to greatly benefit from upgraded management of all of the potential rhino habitat in Dudwa as it shares the habitat requirements with the rhino. The maps of the Dudwa national park and the RRA appear at Fig 1 and 2 respectively.

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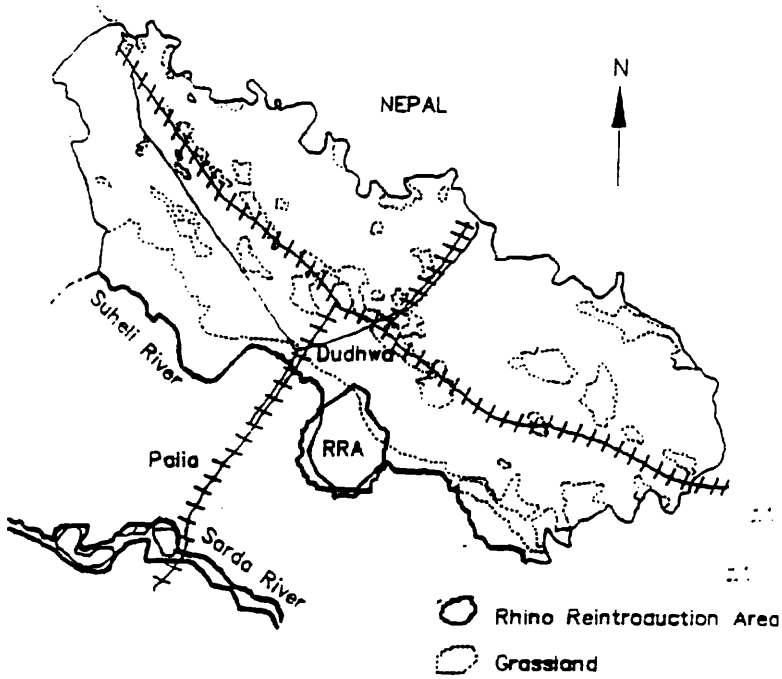

Fig. 1. Map of Dudhwa Tiger Reserve/N.P.

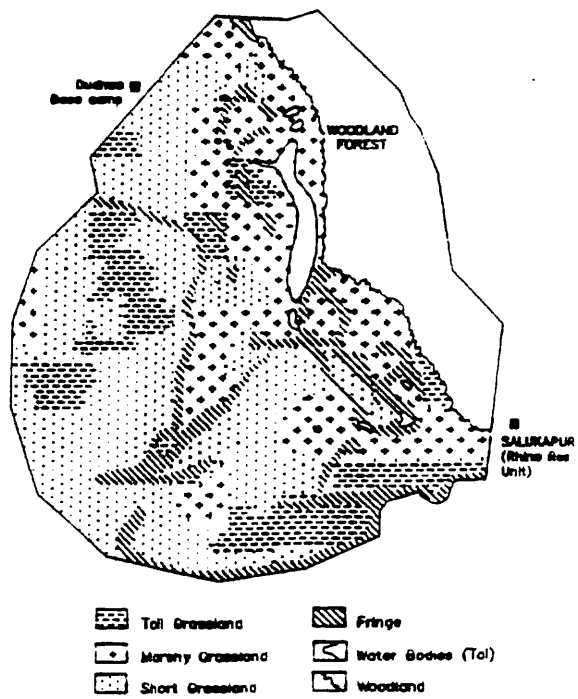

Fig. 2. Habitat Map of Rhino Re-introduction Area (RRA)

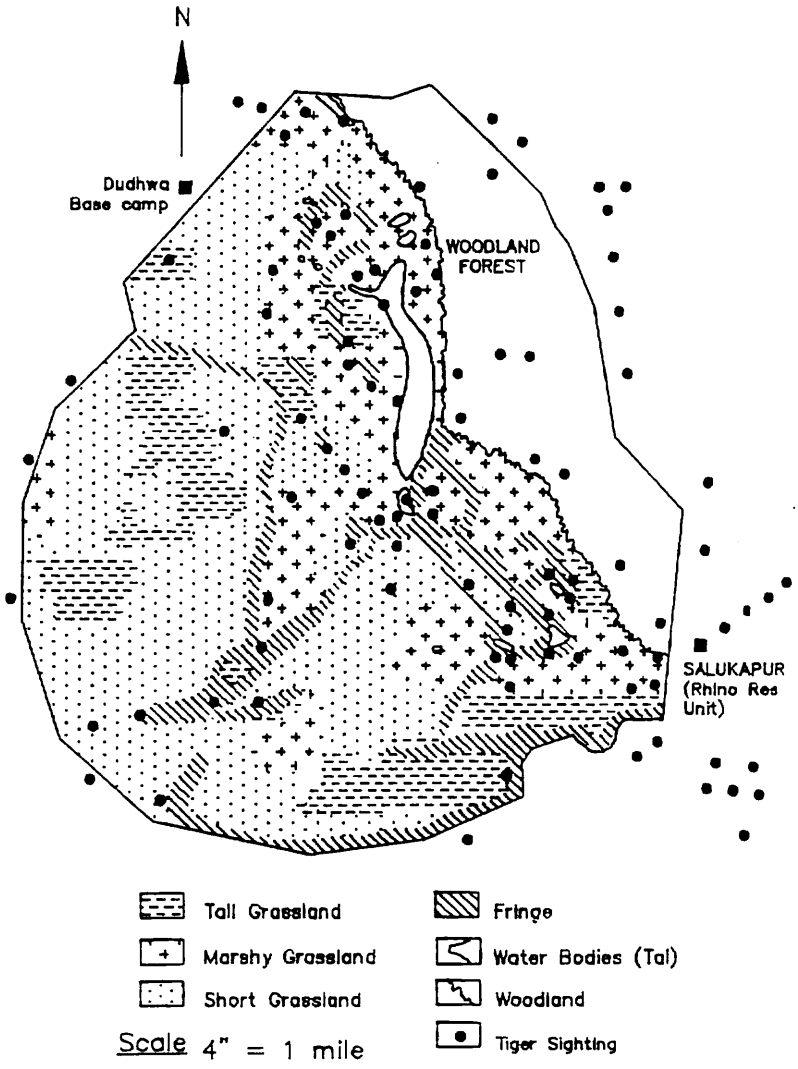

Fig. 3. Tiger movement in Rhino Re-Introduction Area (RRA)