

PERFORMANCE OF A TRANSLOCATED POPULATION OF GREATER  
ONE-HORNED RHINOCEROS IN NEPAL

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ABSTRACT

In 1986 13 rhinos (5 males and 8 females) were translocated from Royal Chitwan to Royal Bardia National Park in lowland Nepal. Following erratic and extensive movements by some individuals during the first few years (up to 100 km loop outside the park), in 1990 animals were settled in large home ranges (mean ca 28 km<sup>2</sup>) within 20 km of the release site. Eight years after translocation, 15 animals were spread over an area of 70 km<sup>2</sup>. Of the original transplants, six died due to injuries contracted during transport (1 male), poaching (1 male and 1 female), fighting (1 male), natural death (1 female, presumably during calf birth) and unknown cause (1 male). A total of 11 calves were born, 10 from the original female group

and 1 by a female calf born in 1987. One or two females of breeding age did not conceive during the 8 year period, probably due to social incompatibility and/or temporary lack of breeding males. Mean calving interval (N = 4) was 52 months (4.3 years), and age at first parturition of one female was 6 years, both similar to the donor population in Chitwan. One male bred at maximum age of 10 years, a younger age than reported in Chitwan. Two of the calves (18%) died within one year due to tiger predation (1) and loss of mother (1). In addition, 1 female was poached at age of 5 years. Growth of the Bardia founder population was depressed mainly due to direct and indirect effects of poaching: since release in late 1986 to end of 1994 (8 years) number of animals increased from 13 to 15. In the absence of poaching and other irregular deaths, breeding and net recruitment would have been close to the maximum potential of the species, indicating that the habitat in the Karnali floodplain is of adequate quality to sustain a small population of this endangered species.

## INTRODUCTION

The world population of the greater one-horned rhinoceros (*Rhinoceros unicornis*) numbers less than 2000 animals, distributed mainly in two national parks, one in Kaziranga in India, the other in Royal Chitwan in Nepal (Khan and Foose 1994). To safeguard the species against eradication from disease or other calamities, animals have been translocated from Chitwan to Dudhwa NP in India (Sale and Singh 1987) and to Bardia NP in Nepal (Mishra and Dinerstein 1987, Bauer 1988, Jnawali and Wegge 1993). No field study has yet been conducted which accurately describes the fate of animals after their release in a new environment. Such information is valuable when designing future translocations of large

## RESULTS

### Dispersal and settlement

Dispersal following release has been described by Bauer (1988) and Jnawali and Wegge (1991, 1993). One of the two adult males died after one week 0.5 km from the release site probably due to injuries contracted during transport. Six of the remaining 12 founders made extensive movements after release, whereas the others moved only a few km and settled with activity centers within 10 km of the release site. Longest trek was made by an adult female, the "Indian nomad": within 5 days she moved about 40 km SE through mainly cultivated fields and settlements to near the airport of Nepalgunj town, whereupon she turned back to enter the floodplain south of the Indian border, about 25 km south of the release site. Three years later, she appeared in the central part of the floodplain and was radio-collared. She gave birth to a male calf in the monsoon 1990 and remained in the southern section of the study area until she moved back permanently to the south of the Indian border in November 1991. One subadult male dispersed about 30 km SW near the Indian border, stayed there nearly two years, then moved 40 km northwards where it was poached. Another subadult male first moved 20 km southwards and established a temporary home range there. Three years later he moved north and was radio-collared shortly south of the release site. Soon thereafter, he moved south again and remained near the border until mid 1990. He then moved north and established a new home range in the central part of the floodplain. Two of unknown sex and age travelled 15 km north, spent two years near the Karnali gorge and then returned to near the release site, probably disturbed by bridge construction activities. The last animal to make erratic movement was another adult female: following release she moved eastwards 8 km out of the park, gave birth and remained there for two years, then returned

to the floodplain shortly south of the original release site.

Three of the six "dispersers" did not track preferred habitat during initial dispersal: instead of moving within and along the floodplain of similar habitat as in their original environment in Chitwan, they travelled directly across unsuitable sal forest, cultivated fields and populated areas, only resting temporarily in remnant patches of degraded forest. When failing to find suitable and undisturbed habitat, they returned back to the general area of the release site.

One of the subadult males probably dispersed out of the Park. During the first few years, unsubstantiated reports indicated his presence in the floodplain, but since 1989 we have no reliable information of his whereabouts or destiny. It is assumed that he died from unknown causes.

Five years after the initial release, the surviving 10 animals had spread out and settled in an area of about 70 km<sup>2</sup> (Fig. 2). Home ranges were large, ranging from ca 12 km<sup>2</sup> (smallest female range) to 45 km<sup>2</sup> (largest male range), which was about ten times larger than in the donor population (Jnawali and Wegge 1993). During the next two years seasonal and annual home ranges did not decrease in size, indicating that ranging behaviour was site specific, reflective of different composition and dispersion of preferred habitats and lower population density than in Chitwan (Jnawali and Wegge, in ms). With the loss of three males, the adult sex ratio was highly skewed, consisting in 1990 of 2 males and 8 females (Table 2).

#### Breeding and reproduction

Two of the adult females were pregnant when translocated and calved in Bardia the following year. Subsequently, 9 calves were born. Four females calved twice with calving

interval ranging from 48 to 58 months (mean 52 months or 4.3 years). The sex of seven calves was 4 male and 3 female. The first born female calf gave birth at the age of 6 years, assuming a gestation period of 16 months (Dinerstein and Price 1991). Following the death of one of the two adult males shortly after release, the other adult was dominant and mated most females until early 1990. He occupied the northern and central part of the floodplain and sired three of the first four calves born. An original subadult male who resided in the extreme southern part, bred the "Indian nomad" in winter 1989, at a maximum age of 10 years. In 1990 he moved north and challenged the older dominant male. After injuring him badly and displacing him to the northern part, he killed him in early winter 1992. Since then, he has been the dominant breeder and sired all subsequent 6 calves born to the population.

Nearly all breeding age females have calved within expected time intervals. Among the 3 nonpregnant adults translocated in December 1986, one calved in September 1988 and one in the monsoon (July-August) 1989, indicating that they conceived during one of their first estrous cycles. The third adult ("Indian nomad") did not breed before winter 1989, presumably because she occupied the southern part of the floodplain where only the subadult male was then present. Once he became sexually mature (and later "took over" the floodplain), she mated with him. Among the three originally subadult females, one calved in 1991 at an estimated age of 10-11 years. At least one of the two remainders have not yet given birth. A recently born calf (1994) may have been born to the last original subadult or to a female calf born in 1987.

Most calves were born during the monsoon: seven of nine calves were born during July-October, and two late in the hot season. With a gestation period of 16 months, mating appears to have been concentrated to the early part of the dry season (December-March).

## Losses

Of the original founder population of 13 animals, seven died during the 8 year period. In addition, 2 of the 11 new calves died. Poaching was the most important mortality factor, responsible for a minimum of 3 of the known deaths. As a young adult, one original subadult male was killed west of the park near settlements while he was expanding his home range northwards, presumably in search of settled females. One adult female was poached near park headquarter inside the park 6.5 years after release, shortly after having given birth to her second calf. Her orphaned calf died a few weeks later, presumably due to starvation or malnutrition. Her first calf, a 5 year old female, was poached the year before just outside the park border.

Another adult female colonizer was found dead in sal forest outside the periphery of her home range with an unborn, fullterm calf. Circumstantial evidence indicated that she may have died from complications during late pregnancy or calf birth.

The only successfully established adult male was killed by a younger male in 1992. The fight took place west of Geruwa river, the park border, near cultivation and settlements. It started late in the evening and lasted until early morning. The loser may have been physically weakened from previous interactions with the same male, as ten months earlier he was seriously injured in another fight with the younger male. The location of the fight was 20 km north of the latter's previous activity center near the Indian border.

In spite of a dense tiger population (Støen 1994), predation by tiger has killed only one calf so far. The calf was less than 6 months old. Hence, 10 of 11 calves survived tiger predation during their first 6 months of life.

## DISCUSSION

After 8 years, the translocation of 13 individuals has led to the establishment of a seemingly healthy, well-producing population of 15 animals in the Karnali floodplain. Breeding and reproduction has been "normal", with animals performing according to the biological potential of the species: the observed calving interval of 52 months and age at first reproduction of 6 years compare quite closely with an interval of at least 48 months and 6-7 years recorded in the donor population in Chitwan (Dinerstein and Price 1991). Also, male breeding at maximum 10 years of age was quite young compared to Chitwan, where all except one out of 28 breeders were estimated to be  $> 15$  yrs (Dinerstein and Price 1991). The unusual situation in Bardia probably explains this rapid breeding recruitment: due to very dispersed animal distribution, the dominant male was spatially out of contact with the female when she went into estrous and she accepted the 10 year old male for mating.

In Bardia, most calves were born during the monsoon, indicating some synchronization in mating. In a much larger sample in Chitwan, Dinerstein and Price (1991) reported no evidence of seasonal breeding. However, Laurie (1978) found a tendency for more births to occur during the monsoon and winter in the same population. Since our sample was quite small, it is too early to say if seasonal breeding indeed will "evolve" in the translocated population.

Breeding commenced quickly in the translocated population. Aside from two females that were pregnant during transportation and which delivered successfully some months later, the first conception must have occurred in Bardia 5-6 months after release. Although some females were not bred during their first estrous cycle, most of them conceived soon after they had settled in their new environment.

However, despite high reproductive potential, population growth has been quite slow, due mainly to poaching and stochastic events. Poaching of an adult female led to the loss of her newborn calf. The death of another female, probably due to physiological abnormalities during the terminal stage of pregnancy, also led to a loss of one calf. Further, the early death of two males may have delayed breeding among some females due to social disorder combined with a skewed sex ratio and spaced out distribution of breeding females: during the one year period when the young adult male was displacing the only adult breeding male, some females probably ovulated without conceiving because they were spaced out over a very large area.

The habitat quality of the Bardia founding population is seemingly quite adequate considering the breeding performance and survival rate of calves. Recent habitat and food studies also support this (Jnawali in ms.). However, the small population is already causing difficult problems for park management. Locally, severe crop damage problems have already developed as animals move outside the park border and forage on maturing crops of maize, rice and lentils during the latter part of the monsoon and early dry season (Bhatta 1994, and pers. obs.). The large home ranges and extensive movement of individual animals are interpreted to be a result of preferred habitats being small and dispersed, coupled with founders being recruited among habituated crop raiders in Chitwan (Jnawali and Wegge 1993, and in ms.). With strict control of poaching, the population is expected to increase more rapidly in the years to come, as the population now consists of 1 subadult and 7 adult females, and 1 adult and 2 subadult males, and 4 calves less than 4 years of age. This will inevitably lead to more crop raiding and harassment to local villagers. A major effort is therefore needed to reduce the conflicts with local communities. Since most of the "hot spots" are in localized and well-defined areas, electric fencing, combined with specially designed



trenches (Jnawali 1989), are the recommended methods to solve the management problem.

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Table 1. Composition of the founder population released in the Karnali floodplain of Royal Bardia National Park in 1986.

Translocation time	Total number	Adult males	Adult* females	Subadult males	Subadult females
February 1986	4	0	1	1	2
December 1986	9	2	4	2	1
Total	13	2	5	3	3

\* Two females were pregnant when translocated

Table 2. Mortality and recruitment of the founder population of 13 animals (5 males and 8 females) in Royal Bardia National Park during eight years after translocation.

Year	Mortality	Recruitment	Status end of year			Total
			M a/s	F a/s	C*	
1986	1 ad. male from injuries		2/2	5/3	0	12
1987		2F	2/2	5/3	2	14
1988	1 young ad. male dispersed and dead	1F	3/0	8/0	3	14
1989	1 young ad. male poached	1M	2/0	8/0	4	14
1990		1M	2/0	8/0	5	15
1991		1M	2/0	8/2	4	16
1992	1 ad. male from fighting 1 ad. female natural death 1 subad. female poached 1 calf (<6 mo.) predated	1F 1	1/0	7/2	4	14
1993	1 ad. female poached 1 orphaned calf dead	1M 1	1/1	6/2	4	14
1994		1	1/2	7/1	4	15

a = adult (>6 years), s = subadult (4-6 years), C\* = calves (<4 years)

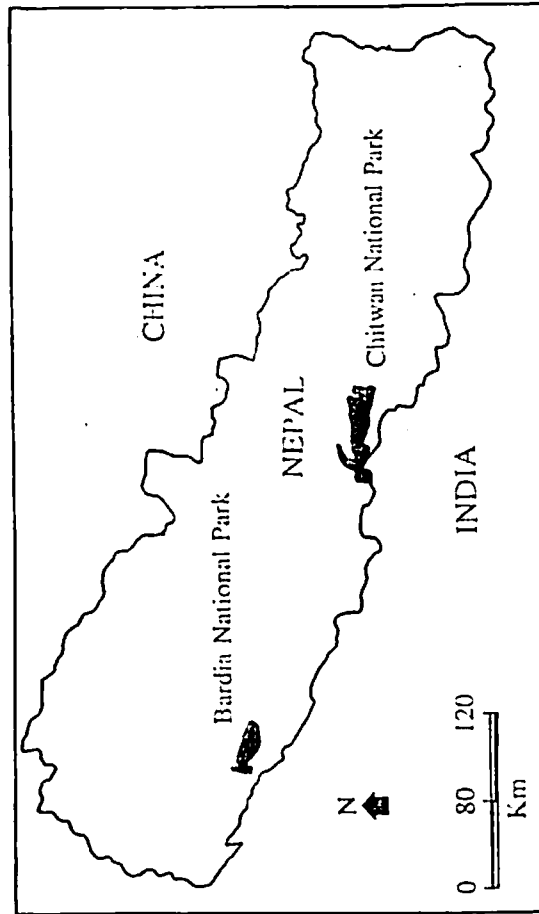


Figure 1. Map showing location of Chitwan NP (donor population) and Bardia NP (translocation) in Nepal.

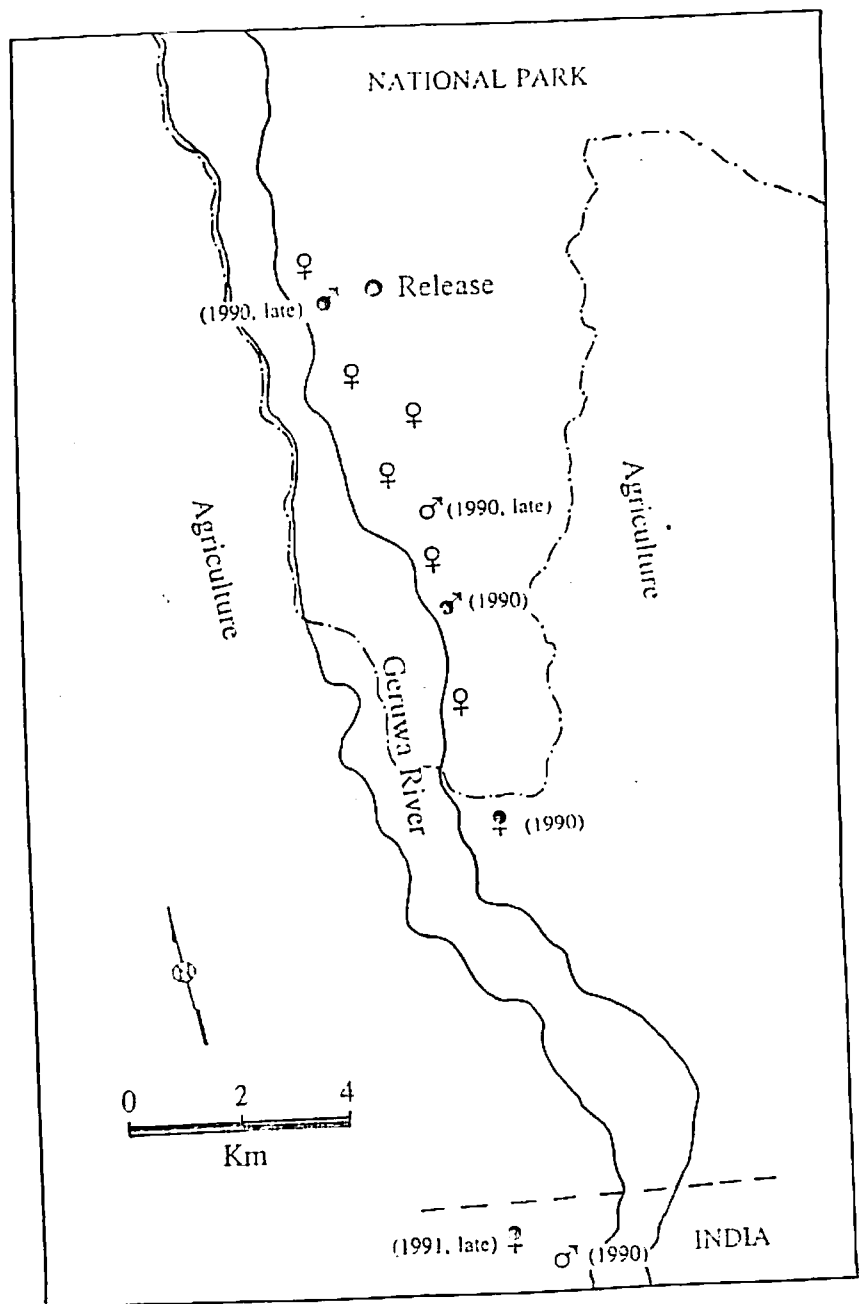


Figure 2. Release site (1986) and distribution of activity centers in 1990/91 of the translocated rhinos. ♀ Indian nomad, ♂ older male, ♂ younger male (see text).