The colonization of a new area in the first six months following 'same-day' free release translocation of black rhinos in Kenya

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Abstract

In February 2007, 27 black rhinos (*Diceros bicornis*) were translocated to an area in the Ol Pejeta Conservancy in central Kenya that contained no resident population. The rhinos were 'free' released on the same day of their capture at 11 sites spread throughout the new area in order to minimize future conflict. Free release had not been tried on such a scale in Kenya. Following release, the rhinos were closely monitored through radio tracking and direct observation to record their movements and how quickly they settled in their new environment. In the first six days after release, 17 of the 27 rhinos remained close to their release sites while one individual travelled 35.1 km. All rhinos bar one settled within six months of release; 16 had settled within 25 days. The rhinos moved on average 7.69 km from their release sites with 14.57 km the maximum distance moved. With no reported fights between conspecifics and the ease of settling of the rhinos in their new location, the results obtained from the free release translocation used at Ol Pejeta Conservancy show it to be a useful alternative approach to future rhino translocations.

Résumé

En février 2007, 27 rhinocéros noirs (*Diceros bicornis*) ont été transférés dans une région de la Conservation d'Ol Pejeta au centre du Kenya qui n'avait pas de population résidante. Les rhinocéros ont été relâchés « libres » le même jour de leur capture dans 11 sites répartis dans la nouvelle aire pour minimiser de futurs conflits. Le relâchement libre n'avait pas été essayé à une telle échelle au Kenya. Suivant le relâchement, les rhinocéros étaient suivis attentivement à travers un dépistage par radio et une observation directe pour enregistrer leurs mouvements et constater la rapidité avec laquelle ils s'établissaient dans leur nouvel environnement. Dans les six premiers jours après le relâchement, 17 des 27 rhinocéros sont restés près de leur site de relâchement tandis qu'un individu a voyagé 35,1 km. Tous les rhinocéros à l'exception d'un seul s'étaient établis endéans six mois de leur relâchement; 16 s'étaient établis dans 25 jours. Les rhinocéros se sont déplacés en moyenne de 7,69 km de leur site de relâchement avec une distance maximale de 14,57 km de déplacement. Etant donné l'absence de combats rapportés entre congénères et la facilité d'établissement des rhinocéros dans leur nouvel site, les résultats obtenus de la translocation de relâchement libre utilisée dans la Conservation d'Ol Pejeta montre que c'est une autre approche utile pour les translocations futures des rhinocéros.

Introduction

In 2004, the 9700 ha Sweetwaters Game Reserve, part of the 36,500 ha Ol Pejeta Ranching Limited situated in the Laikipia area of central Kenya was purchased by Fauna and Flora International**,** a UK based conservation organization. The Reserve was subsequently extended to encompass most of the ranching area to create the 'Ol Pejeta Conservancy'. At the time of purchase, Sweetwaters was home to 46 critically threatened black rhinos while there were none in the ranching area. The creation of the Ol Pejeta Conservancy made a further 20,000 ha available for black rhinos.

The habitat of the release area at Ol Pejeta was considered ideal for black rhinos because of the high quality browse species *Acacia drepanalobium* predominated the tract while the southern area was comprised of dense *Euclea divinorum* for security. With no previous rhino population in the new area, the browse and cover was in good condition.

Solio Game Reserve, a 6800 ha area of Solio Ranching Limited, lies some 60 km south of Ol Pejeta. At the start of 2006, a population census of black rhinos at Solio confirmed 85 individuals, of which there was a major sex bias to males, which required urgent management attention (Patton et al. 2007). This high density population had existed without apparent behavioural problems. A habitat survey of the Reserve by Adcock et al. (2007) showed a significant degradation of quality rhino browse, particularly of *Acacia drepanolobium*, which records showed had been predominant, similar to the browse of the planned release area at Ol Pejeta. It was thus concluded that the level of population represented a significant over-capacity. Translocating individuals out of Solio in the proportion of two males to one female was recommended to help reduce the over-capacity and re-balance the skewed sex ratio, particularly among the younger age groups (Patton et al. 2008). Space, as mentioned above, was available at Ol Pejeta for 30 rhinos from Solio.

Following agreement among Ol Pejeta, Solio, Ol Jogi and the Kenya Wildlife Service (KWS), the translocation plan was revised to also include a transfer of four black rhinos to Ol Jogi, another rhino sanctuary based in Laikipia north of Ol Pejeta.

The translocation was planned for 15 January, having been postponed from the previous September, but due to unseasonal rains the project could not begin until 3 February 2007.

Pre-translocation planning

Due to the close proximity of the donor and recipient areas, the translocation was planned to be 'free release' (untried on such a scale outside of South Africa), rather than boma release, as was typical in Kenya. In boma release, the rhinos are transported to the release site and then held for days or weeks in a group at a boma. They are subsequently released one at a time during a sequence of evenings from those bomas. Free release on the other hand, involves the transport of individual rhino to their own separate release sites that are spaced throughout the new reserve and, in this case, released on the same day that they are captured. While boma releases have been common in Kenya, the concern is that when releasing large numbers of rhinos from the same place, it increases the encounter rates among them and therefore the potential for conflict also rises (Linklater et al. 2006).

In larger reserves the release of individual rhinos at different sites spaced throughout the reserve might reduce post-release encounter rates and conflict. Free release allows many more rhinos to be released each day and for the entire group to be released over a shorter period of time than would be possible if the rhinos were released from a boma complex. This is because boma releases require that the rhinos are released at different times and that there be sufficient time between each release to prevent interactions that might result in conflict. The common procedure is to release one rhino at dusk on subsequent days (Linklater et al. 2006).

The time that it takes to release all individuals is a potentially important consideration because the expectation regarding rhino home range or territorial behaviour is that once having established themselves, a rhino is more likely to respond to a newcomer aggressively. Thus, shortening the length of time between the first to the last release means that the rhinos are more equally uncertain about their home and thus less inclined to defend it.

Free release enables rhino release sites to be spaced across the reserve thus further limiting the probability of rhino encountering one-another during the critical period when they are recovering from the anæsthetic drugs and experience of transportation and release. Boma releasing means that each subsequent rhino that is released is likely to encounter the previously released rhinos earlier and the rates of encounter might increase as the release schedule proceeds. The problem is exacerbated if rhinos initially do not move far from the boma after release. Some rhinos are reluctant to leave the boma, do not travel far in the initial few days of release and may return to the boma after release (Linklater et al. 2006).

The recommended release plan entailed the identification of five release sites where there was appropriate habitat for the rhinos' security, food source and water. A social unit of six rhinos were to be released at each of the sites—two mature males, two immature males and two mature females. It was suggested that this system could reduce the need for

the released rhinos to wander around the new area, thereby reducing possible conflict. Release sites were identified and access pathways made, unloading ramps built and any repairs to water points undertaken. Seven release sites were constructed with two 'spare'—one if there was a problem with any of the five main sites and one designated for 'emergencies' such that, for any reason, a rhino could be released immediately when it was inside the new area.

Discussions were held with interested parties regarding the selection of candidates for removal from Solio. A series of guidelines was drawn up and followed to produce a candidate selection list. Of paramount importance was that, after translocation, there should be a population with balanced sex ratio in Solio and Ol Pejeta as a whole; i.e. among the new and the existing populations combined. In order to complete the candidate list with 20 males and 10 females, it was agreed that one 'cow/calf' combination—an adult female with a 1-2 year old male calf—would be tried as this had been carried out successfully in South Africa (D.V. Cooper, pers. comm. January 2007). All the translocated rhinos were to be fitted with horn implanted radio transmitters (Mod-080 rhino implant with MDC duty cycle, Telonics Inc.).

Pre-translocation action

Using a Garmin 12 GPS handset and Trackmaker software, a new map of the fence line, important roads, water-points, gates, corridors, patrol camps and other key features was produced. For the management of security, the Conservancy had been divided into 17 'blocks', each designated by a letter from 'A' to 'V', with blocks 'J' to 'V' representing the area. These blocks were superimposed on the new map and copies published and laminated for long-term use.

The existing custom-built, 'Sighting' database required modification to enable the recording of the additional rhinos; macros were altered or written for this. In addition, a new 'Signal' database was constructed to record data from the radio transmitters that were fitted to the relocated rhinos. New report sheets were devised and produced for patrol teams to complete. All the patrols in the new area were trained in the key GPS functions required for monitoring and issued with the new GIS block map. Members of the management staff were also given the block maps. A Translocation Record Form and a Release Record Form were designed and produced to enable all relevant information about the translocation process to be recorded for each rhino.

Plans to remove the fence dividing the new area and the existing 'old' reserve were brought forward to relieve the density pressure of the individuals in the old reserve. Originally there was to be a two- to three-month settling in period for the newly moved rhinos, but fence removal was started in the middle of March, some 30 days after the last rhino was released in the new area. By 22 March, all the fencing along the west boundary had been taken down. This abutted an area where several of the new rhinos were located. In case rhinos crossed from the old area into the new area, appropriate identification booklets were produced and given to the four patrols monitoring the border areas.

All of the rhinos except one and the calf (of the cow/calf combination) translocated to Ol Pejeta were fitted with radio transmitters. With 10 individuals, where one of the horns was substantial enough, the transmitter was fitted without cutting the horn as this makes subsequent field identification easier. Fifteen rhinos had one of their horns cut. All rhinos were ear notched and wherever possible, photographs were taken of the new horn pattern and the ear notches. For the latter, high quality photographs were obtained by taking the pictures from the outside of the crate through the observation hole at the front once the rhino had been secured inside.

Post-release monitoring

Identification photographs taken at the time of capture were combined with photographs taken prior to the translocation but altered (using the clone tool in Corel Paint Shop Pro software to brush out horns so that they looked like they had been cut off) to represent how the rhino would look after the transmitter was fitted. Twenty-four photo-identification booklets of the translocated rhinos were produced. The pictures used were made into a Microsoft PowerPoint presentation and 15 patrols and the managers were trained in the key identification features for each rhino.

Two radio tracking teams were established. One team was always on hand to meet the capture team vehicles and receive the Release Record Form that noted the details of the rhino being released, including the frequency and channel of the radio transmitter fitted. Since most releases were in the late afternoon,

at or near the time that the transmitters were placed, the team were able to check that all the equipment was working satisfactorily before the rhino wandered too far. All but two transmitters were found to work correctly. One appeared to be incorrectly timed and the other only produced a clear signal when close, emitting an audible but incorrect sound from a distance.

The signal data were collected daily by visiting 'high points' particularly Marbe Hill at the far west of the Conservancy where it was possible to pick up the signal of most of the rhinos. Depending on the strength and position of the signal received, an estimate of the block the rhino was in was made. When all the signals had been received, if a rhino had not been sighted for 7+ days, it was more intensively tracked. Three transmitters caused problems: that of Moigo seeming to be starting/stopping outside the programmed duty cycle times; Gideon's issued an abnormal sound from a distance; and Upendo's emitted a barely audible signal at best. The rhino Njoki did not have a transmitter fitted. On occasions, the signal from Hatari was interrupted by local armed forces communications.

For at least the first two weeks after release the team decided not to seek the rhinos visually in order to minimize the potential disturbance to the rhinos so they could settle as quickly as possible. Only the radio signal for each rhino needed to be recorded and this was done twice per day. However, some rhinos were opportunistically sighted during the normal course of security patrols. After the initial release period, the 13 patrols and the vehicle-based monitoring team aimed to sight and record the location of each rhino at least every six days.

Signal and sighting records were amalgamated into one dataset and analysed for each rhino in 10-day sections comparing the proportion (as percentages) of the records in each block visited by the rhino. This enabled the translocation team to make some tentative conclusions about the level of 'settling' by each rhino.

Statistical analysis

The system employed for obtaining signals, as mentioned above did not allow for an opportunity to refine the estimated location of the blocks allocated to the remaining rhinos such as carrying out triangulation or obtaining a GPS record. A rhino near the border of two blocks could have been given the wrong location, therefore block data should be treated with caution.

Despite the translocated rhinos being ear notched, identification training undertaken and identification booklets distributed, the opportunity

Table 1. Distribution of rhinos at release sites

Release site	Rhino name	Rhino name	Rhino name	Rhino name	Rhino name	Rhino name
1	Ainoa **F**	Chege **M**				
2	Kati **F**					
3	Moigo **M**					
4	Mbaluki **M**	Karime **M**	Muuna **M**	Zoa **M**	Owour **M**	
5	Upendo **F** & calf Kiriamiti **M**					
6	Njeri **F**					
7	Sarajane **F**					
8	Nwanku **M**	Sub **F**				
9	Hatari **M**					
10	Zulu **M**	Gideon **M**	Ojwang **M**	Njoho **M**	Kimbo **M**	Njoki **F**
11	Inspector **M**	Irungu **M**	Nduta **F**	Kaka **M**	Dada **F**	

F=female
M=male

existed for mis-identifications—especially in the early months while individuals were moving around the new area and particularly as many rangers were newly employed. In addition, rangers inexperienced in using GPS may have incorrectly recorded locations. All these are likely sources of error in the data gathered.

No references were found that used block data as is used in this study. It is too imprecise to use for home range analysis and there were insufficient GPS data to produce minimum convex polygons.

Due to the imprecise nature of the method of collecting block data, the high potential for error in collecting and recording GPS data, some gaps in the data and with the relatively low number of rhinos involved, it was not considered appropriate to undertake statistical analysis of the data collected. This project was driven by practical considerations, which changed on a daily basis, particularly centred on the welfare of the particular population of rhinos. However, the data is considered sufficiently robust to extract general trends to aid in informing the management of future translocations.

Translocation results

Four rhinos, two males and two females, were moved from Ol Jogi to the Ol Pejeta new area at the rate of two rhinos per day. Twenty-six rhinos, 18 males and 8 females, were moved from Solio. This took 13 days, with an average of two per day. Twenty-three of the rhinos went to Ol Pejeta and three to Ol Jogi.

All the rhinos were free released but the release pits that had been prepared were only used once. It was decided that, in practice, the pits and their use could result in a rhino being injured in the process of moving away from the carrying crate. Instead, crates were placed on grassy areas at ground level near to or in a bush line. Eleven release locations were used with one to six rhinos being released from each (Table 1). Changes to the number of rhinos being moved, weather conditions and practical factors affected the plan to release the rhinos in social units.

The first 6 months after translocation

These results present the analysis of data up to the end of August 2007. There were over 450 sighting and signal datasets in each 10-day period in the first six months of monitoring with a total of 7754 datasets collected. There were 946 sightings where GPS location data was collected with an average of 31 per rhino (range 25–72; n=27). The average number of rhinos found per day was six and the average number of sightings for each rhino per month was seven, (range 5–14; n=26).

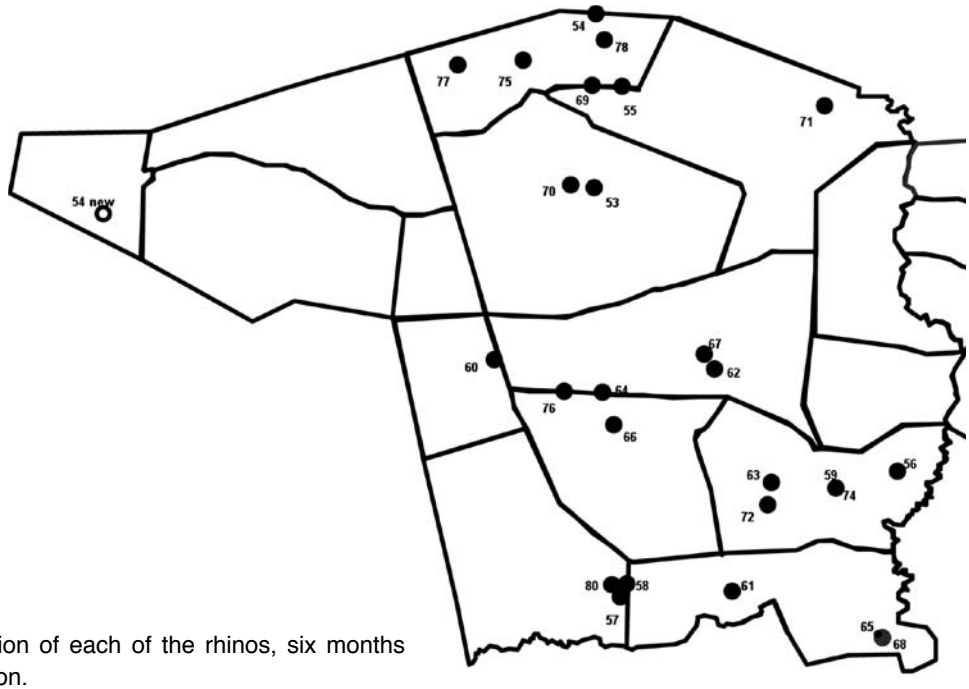

Figure 1. Location of each of the rhinos, six months after translocation.

Table 2. The use of blocks in 10–day intervals

Signal		Percentage use of block by rhinos												
number	Days	J	K	L	M	N	O	P	Q	R	S	T	U	V
26	Release	0%	8%	27%	19%	19%	27%	0%	0%	0%	0%	0%	0%	0%
230	1-10	8%	10%	1%	13%	23%	14%	6%	1%	1%	11%	8%	3%	0%
347	11-20	11%	14%	5%	13%	12%	10%	7%	1%	1%	7%	18%	0%	0%
375	21-30	10%	10%	10%	15%	13%	13%	9%	1%	2%	7%	10%	0%	1%
394	31-40	16%	9%	12%	15%	13%	10%	6%	1%	1%	3%	11%	0%	2%
353	41-50	19%	9%	8%	15%	15%	15%	7%	0%	1%	5%	4%	0%	2%
330	51-60	18%	11%	8%	19%	15%	15%	5%	1%	0%	4%	4%	0%	1%
349	61-70	21%	11%	3%	17%	19%	15%	5%	0%	0%	3%	5%	0%	0%
375	71-80	15%	10%	5%	24%	21%	13%	5%	0%	0%	3%	5%	0%	1%
354	81-90	18%	10%	5%	23%	17%	13%	6%	0%	0%	1%	5%	0%	1%
423	91-100	17%	11%	3%	27%	19%	10%	9%	0%	0%	2%	2%	0%	0%
484	101-110	16%	12%	6%	27%	15%	7%	10%	0%	2%	0%	4%	0%	0%
483	111-120	17%	13%	5%	25%	15%	7%	10%	3%	0%	2%	3%	0%	0%
480	121-130	15%	16%	5%	24%	11%	5%	14%	2%	1%	1%	3%	0%	2%
448	131-140	17%	14%	9%	19%	13%	6%	16%	1%	1%	2%	4%	0%	0%
455	141-150	19%	14%	6%	21%	9%	5%	18%	2%	1%	1%	4%	0%	1%
476	151-160	19%	14%	8%	19%	9%	6%	17%	0%	0%	0%	7%	0%	0%
450	161-170	15%	14%	9%	22%	8%	6%	17%	1%	0%	1%	5%	0%	0%
479	171-180	15%	14%	7%	24%	9%	8%	14%	1%	2%	2%	7%	0%	0%
469	181-190	15%	13%	6%	24%	4%	7%	18%	1%	1%	1%	8%	0%	2%

While there are some short-term fluctuations in the blocks favoured by the rhinos, it can be seen that the rhinos showed their preference from around 100 days. Blocks J, K, M, N, O and P are the most used (around 80%) with blocks Q, R, S, U and V rarely used (around 5%). At the end of the reporting period, 4 of the 13 blocks in the new area (J, K, M and P), represented the blocks favoured by 20 of the 27 rhinos (74%) (Table 3).

Table 3. Number of rhinos in each block at 10 day intervals

block	J	K	L	M	N	O	P	Q	R	S	T	U	V
release	0	3	7	5	5	7	0	0	0	0	0	0	0
day													
10	3	4	0	4	5	2	1	0	0	4	4	0	0
20	2	4	3	2	4	5	2	0	0	0	5	0	0
30	7	3	2	3	2	6	3	0	0	0	1	0	0
40	6	2	3	3	6	3	2	0	0	0	2	0	0
50	6	3	4	4	3	3	2	0	0	1	1	0	0
60	6	4	1	4	6	3	1	0	0	1	1	0	0
70	6	3	0	6	6	3	1	0	0	0	2	0	0
80	5	3	1	6	6	3	1	0	0	0	2	0	0
90	5	3	0	7	4	2	3	0	0	1	2	0	0
100	7	4	0	7	4	2	3	0	0	0	0	0	0
110	4	5	2	5	5	1	4	0	0	0	1	0	0
120	4	5	1	6	4	2	2	1	0	1	1	0	0
130	5	5	0	6	3	1	5	0	0	1	1	0	0
140	7	4	2	4	3	1	5	1	0	0	0	0	0
150	5	4	1	4	2	1	6	0	0	0	3	0	1
160	4	5	0	6	2	2	5	0	0	0	3	0	0
170	4	5	1	5	3	2	4	0	0	1	2	0	0
180	4	4	0	7	1	2	5	0	0	1	3	0	0
190	5	4	0	6	0	2	5	1	0	0	3	0	1

The block data analysis shown in table 3 suggests that 26 of the 27 rhinos in the new area settled their ranges within 6 months of release, although longer-term data will be needed to confirm this. Only the male Njoho continued to move throughout the reserve. The time to settle ranged from 1 to 93 days (Table 4), with an average of 25 days (n=26); 16 of 26 (61%) settled within 25 days of release. Adult females took between 1 and 41 days, with an average of 14 days (n=8); adult males between 1 and 93 days, with an average of 30 days (n=18). Twelve rhinos moved from their original settlement area at between 43 and 126 days, average 101 days, with four of these rhinos making a second change at between 131 and 167 days, average 148 days.

Table 4. Time taken for rhinos to settle and further changes

Rhino no.	Rhino name	Rhino sex	Release block	Block day 1	Block settled	Days to settle	Block day 100	Block change 1	Day change 1	Block change 2	Day change 2
53	Ainoa	SAF	O	N	N	71	N				
54	Chege	SAM	O	N	O	1	P	P	89		
55	Sarajane	F	O	N	N	41	N	P	122		
56	Hatari	SAM	O	O	J	32	J				
57	Zulu	M	L	T	JK	93	TM	KL	126	LT	167
58	Gideon	M	L	L	TL	24	K				
59	Ojwang	M	L	J	JM	1	M	MJ	72	JL	131
60	Njoho	M	L	U	unset-tled		M				
61	Kati	F	K	K	JK	1	J	K	115		
62	Mbaluki	M	M	T	M	21	MJ				
63	Karime	M	M	M	J	28	J				
64	Muuna	SAM	M	N	M	31	M				
65	Upendo	F	K	K	K	1	K				
66	Kimbo	M	L	T	LT	21	M	LM	43		
67	Nduta	F	N	N	M	15	M				
68	Zoa	M	M	J	K	38	K				
69	Owour	M	M	S	NP	18	N				
70	Inspector	M	N	N	N	1	N				
71	Kaka	M	N	N	O	12	0	OP	106		
72	Dada	F	N	P	JMN	2	J	JML	116		
73	Kiriamiti	mc	K	K	K	1	K				
74	Nwanku	M	O	S	JL/M	29	JL				
75	Moigo	M	O	L	P	90	P				
76	Irungu	M	N	O	MN	40	MN	LM	105	M	148
77	Njeri	F	L	O	P	10	QP	PQ	111		
78	Sub	F	O	Q	O	19	O	OP	109		
80	Njoki	F	L	O	J	19	J	LM	95	T	146

Table 5. The distances between the release sites

Rhino name	Rhino Sex	Rhino Age	Release date	Release site	Nearest site	Distance km
Ainoa	F	5.7	03-Feb-07	1	3	1.58
Chege	M	3.9	03-Feb-07	1	3	1.58
Sarajane	F	9	04-Feb-07	7	8,9	0.91, 0.61
Hatari	M	5.1	04-Feb-07	9	7,8	0.61, 0.34
Zulu	M	8	06-Feb-07	10	6	1.16
Gideon	M	12	06-Feb-07	10	6	1.16
Ojwang	M	10	06-Feb-07	10	6	1.16
Njoho	M	14	07-Feb-07	10	6	1.16
Kati	F	9	07-Feb-07	2	5,6	2.39, 2.13
Mbaluki	M	20	08-Feb-07	4	6,11	4.27, 3.81
Karemi	M	8	08-Feb-07	4	6,11	4.27, 3.81
Muuna	M	10	08-Feb-07	4	6,11	4.27, 3.81
Upendo	F	16	11-Feb-07	5	2	2.39
Kiriamiti	M	1	15-Feb-07	5	2	2.39
Kimbo	M	10	11-Feb-07	10	6	1.16
Zoa	M	15	11-Feb-07	4	6,11	4.27, 3.81
Owour	M	7	11-Feb-07	4	6,11	4.27, 3.81
Inspector	M	25	12-Feb-07	11	4,3	3.81, 4.76
Irungu	M	25	12-Feb-07	11	4,3	3.81, 4.76
Nduta	F	17	12-Feb-07	11	4,3	3.81, 4.76
Kaka	M	13	13-Feb-07	11	4,3	3.81, 4.76
Dada	F	6	13-Feb-07	11	4,3	3.81, 4.76
Muigo	M	20	14-Feb-07	3	1	1.58
Njeri	F	6	16-Feb-07	6	10	1.16
Njoki	F	14	17-Feb-07	10	6	1.16
Sub	F	12	17-Feb-07	8	7,9	0.91, 0.34
Nwanku	M	15	17-Feb-07	8	7,9	0.91, 0.34

The data show that the first recorded (GPS location) distance from the release site averaged 5.5 km (range 0.56-13.32 km; n=26). In the first 6 months, the furthest recorded distance from the release site averaged 7.69 km (range 3.23-14.57 km; n=26).

Table 6. Distance the rhinos travelled from their release sites

Rhino number	Rhino name	First distance moved	Day located	6 day cumulative	Furthest distance	At 6 months from release	Nearest neighbour
4053	Ainoa	13.50	22	14.39	8.52	4.35	0.51
4054	Chege	4.13	4	1.61	6.94	14.96	0.75
4055	Sarajane	2.00	27	1.61	4.22	1.42	0.70
4056	Hatari	1.21	2	3.82	12.63	11.50	1.39
4057	Zulu	7.68	4		7.68	1.75	0.41
4058	Gideon	1.30	34		3.23	1.39	0.30
4059	Ojwang	5.91	4		6.80	5.09	0.07
4060	Njoho	6.18	23	13.09	11.33	5.52	1.73
4061	Kati	5.46	3		5.46	1.06	2.31
4062	Mbaluki	1.55	15	7.81	8.26	0.32	0.47
4063	Karime	0.56	3		7.18	3.23	0.63
4064	Muuna	3.33	21		5.73	2.76	0.90
4065	Upendo	4.00	11		4.65	4.10	0.16
4066	Kimbo	2.17	16		5.86	3.06	0.92
4067	Nduta	0.76	30		5.03	3.15	0.47
4068	Zoa	6.30	35		9.09	7.97	0.16
4069	Owour	8.28	28	10.14	10.77	8.53	0.70
4070	Inspector	4.71	8		7.01	3.15	0.51
4071	Kaka	8.06	4		8.15	7.51	4.43
4072	Dada	4.02	17	14.15	8.64	7.07	0.63
4073	Kiriamiti	4.00	11		4.65	4.10	0.16
4074	Nwanku	4.65	9	13.14	14.57	11.57	0.07
4075	Moigo	6.94	4	35.1	7.53	5.88	1.40
4076	Irungu	8.00	5	8.92	7.96	2.62	0.90
4077	Njeri	13.32	14	8.06	13.54	13.29	1.40
4078	Sub	9.93	11	21.46	5.52	1.86	0.75
4030	Njoki	10.51	1		6.62	1.38	0.30
	Average	5.50	13.6		7.69	5.13	0.86

Discussion

There are few reports that describe the daily movements of black rhinos after their release despite translocation having been a common tool in black rhino conservation for several decades (Emslie 2001). Adcock et al. (1998) commented that monitoring by Hillman 1982–84 Bophuthatswana National Parks Board, unpublished data) and Hansen and Lindemann (1989–95 Bophuthatswana National Parks Board, unpublished data) provided early home ranges in Pilanesberg National Park, while others have reported on the behaviour of individual rhinos as they leave the boma or crate at the release site and before they disappear from view (Hitchins et al. 1972; Hall–Martin and Penzhorn 1977). The research of Linklater et al. (2006), was the first time detailed daily movements had been reported for black rhinos after their translocation and release for reintroduction.

Distance travelled

Raath and Hall–Martin (1989) observed that after a boma release on Vaalbos National Park individuals walked up to 24 km on the first day before resting, while movement analysis after 'free-releasing' 15 black rhinos at individual sites in the Mun-ya-Wana Game Reserve (GR) in South Africa, showed the largest first-day distance travelled from a release site was 6.7 km (Linklater et al. 2006). At Ol Pejeta, only one rhino was seen on the first day after release and it had travelled 10.51 km from its release site. Analysis of the signal location data shows that, on the day after their release, 9 rhinos were recorded in the same block as their release, 11 in a neighbouring block and 7 in a more distant block. An estimate of the minimum distance rhinos had travelled shows an average of 2.4 km (range 1–5 km; n=11) to a neighbouring block and 7.5 km (range 4–13km; n=7) to a distant block.

Nine of the rhinos (33%) were first sighted within four days of release with the distance moved from their release sites varying between 0.56 and 10.51 km, averaging 5.6 km. All 27 rhinos were first recorded within 35 days of release with the maximum distance moved of 13.5 km compared to the overall average of 5.5 km. Vaalbos National Park is 18,120 ha and Mun-ya-Wana GR 18,626 ha while the new area at Ol Pejeta is similarly sized at 18, 000 ha. The furthest distance from its release site that an introduced rhino at Ol Pejeta travelled within the first six months was 14.57 km within the range of 3.23 and 14.57 km and an average of 7.69 km. Our data showed that, in the first six days after release, 17 of the 27 rhinos (63%) remained close (within the same block) to their release site while 10 moved between blocks with a minimum cumulative estimated distance of between 7.81 and 35.1 km. The largest 6-day cumulative distance travelled (35.1 km) is much greater than the 24.4 km recorded in Mun-ya-Wana GR.

Settlement

Linklater and Swaisgood (2008) describe the behaviour and movements of 34 black rhinos released into 12 different sites across South Africa. They reported that the rapidity with which the minimum daily distances travelled declined indicated that rhinos began adopting a settled pattern of more limited movements within 15 days after release and that the process was complete within 25 days. Our results showed that the time taken to remain consistently in a specific area, derived from the block or blocks where the rhino was located using its transmitter signal, varied from 1 to 93 days. Within 25 days, only 16 of the 27 rhinos (59%) were considered settled and one male rhino had not settled within 180 days. Linklater and Swaisgood (2008) reported ongoing variability in maximal movements, indicating that some aspects of the settlement process may not be complete after 100 days. At Ol Pejeta, after initial settling, 4 rhinos moved into another, usually adjacent, area from between 43 and 100 days and a further 8 between 105 and 126 days, with 4 of the 12 making a second move between 131 and 167 days. The data agrees with that of Linklater and Swaisgood in that, in at least 44% of the cases, the settlement process was not complete within 100 days.

Given the low number of rhinos involved, we cannot confidently make conclusions about differences in movement or settling between sexes and ages. However, there appears to be no strong evidence of age or sex biases.

Longer-term data is required before making conclusions about the time taken for the rhinos to move into an area that becomes their first home range (females) or territory (males). In addition, rhino movements may be made with changes in season and resource availability (Lent and Fike 2003; Goettert et al. 2010), analysis of which also requires longer-term data.

Cow/calf combination

Although this was not the first time such a translocation had been attempted in Kenya, it requires special mention since the few previous cases (Lake Nakuru NP, Meru NP in 2004 and 2006 respectively) were not as a result of choice but chance. Despite the final outcome of this translocation being a success, the process was not without its problems. With the benefit of hindsight, to move a Solio combination was inappropriate as there were no records to support the selection of a suitable pair. A strong bond between mother and calf is vital so that the mother would be aggressively defensive of her calf.

In the case of the Solio combination, there was only one candidate pair considered with a calf of appropriate age at the time of the translocation. When darted, the female ran off, leaving the calf behind and making no attempt to find it. The calf went into thick bush and could not be found in a place for darting. Finally, the female had to be released in order to ensure it reunited with its calf (which it did). Capture was repeated three days later with the calf being darted first. Again the female ran off some 2 km from the calf and, while it was successfully captured, it again illustrated a poor response to its calf.

On release, the two crates used for transporting the pair were joined so the mother and calf could reform their bond, but the mother kicked towards its calf, effectively rejecting it. When freed, the mother ran off leaving the calf in the proximity of the crates. The decision was made to minimize further disruption and to leave the crates where they were. On the third day after release, the mother and calf finally met up again and successfully paired thereafter.

In order for a cow/calf combination to have the best chance of succeeding, the choice of the pair, especially the mother, is paramount and that adequate records or knowledge of behaviour should be considered when selecting a suitable candidate pair.

Habitat use

The response to release into a new habitat of translocated rhinos is also commented upon by Linklater and Swaisgood (2008). Their personal observations state that rhinos either hide in dense vegetation for a period during which time they move very little from day to day, or that they travel widely in what appeared to be searching or avoidance behaviour. The behaviour of rhinos hiding has also been observed with rhinos in the Sweetwaters Game Reserve after capture for ear notching. In some cases, an individual would remain in dense cover for many years (Patton, personal observation). The rhinos translocated into Ol Pejeta exhibited both hiding and moving behaviour while, prior to their translocation from Solio Game Reserve, all had been relatively easy to sight and kept within small ranges (Patton et al. 2007). In the first six months of monitoring, seven of the rhinos were noticeably difficult to sight as they utilized dense Euclea habitat while eight were solitary and a further three were mostly seen in an apparent new breeding relationship. Ten of the rhinos were sighted in an interaction more than six times.

Interactions

Linklater and Swaisgood (2008) report that for at least the first 100 days after release, and with the exception of new breeding relationships, rhinos appear to avoid other rhinos; there is a particular tendency for rhinos released at lower densities and in larger reserves to almost entirely avoid associating with other rhinos. Our results also indicated a general preference for solitude with rhinos sighted alone 846 out of 946 times (89%).

In the first six months of monitoring the translocated rhinos, there were 100 interactions, (where two rhinos were sighted at the same GPS location at the same time), out of a total of 946 GPS recorded sightings. Of the 100 interactions, 63 were between a male and a female and only 37 between a male and another male.

Two individuals were initially seen together regularly—the male Zulu with the female Kati on 18 of 29 of Zulu's sightings—until Kati produced a calf. Soon after Zulu was seen regularly with the female Njoki—10 of 20 Zulu's sightings (one of which they were mating). The male Karime was often seen with another rhino—at 30 of 49 sightings of which 12 were with the male Ojwang and 17 with the female Dada.

The cow/calf combination Upendo and Kiriamiti were always seen together and have remained in the area in which they were released into but mostly in thick Euclea dominated bush.

One pair that were always together prior to translocation and were captured together and released at the same site, the male and female Kaka and Dada, did not join up again after translocation. The male Kaka is mostly solitary while the female Dada was initially alone (14 sightings) but then was seen with another rhino at 21 of 30 sightings.

There were interactions between rhinos in the old and new areas with the young male Maendeleo crossing a short distance (around 200 metres) into the new area, first sighted on June 10 and nine further times of which one was with the male Ojwang and another, while accompanied by the female Roberto, with the sub-adult male Hatari.

It remains to be seen from longer-term data whether the new population forms a social organization consisting of a territorial male, a group of two to four females with calves and one or more male or female sub-adults, as has been found in the neighbouring Sweetwaters area (Patton 2010).

There have been no reports of fighting among individuals although the male Gideon lost its rear horn, which could have been due to a fight and the sub-adult male Chege, who suddenly changed location to an area close to the boundary fence while also displaying tolerance (by not running away) of humans. This behaviour has been previously noted as after-signs of stress following a fight with another rhino (Patton, personal observation). These results reflect those reported in Linklater et al. (2006) where the re-introduction in the Mun-ya-Wana Game Reserve produced no evidence of aggression or fighting during the first few days after release with the movements of the rhinos appearing to indicate that they actively and successfully avoided each other, or at least conflicted with each other, during this critical period. This was despite the distances travelled by the rhinos after release, being large relative to the space between release sites, and having the occasion and opportunity to encounter and interact with each other. This was the case at Ol Pejeta. Linklater et al. concluded that free-release, with the releases occurring over as short a time as possible with the rhinos spaced throughout the reserve, appeared to have facilitated this process. Our results support this conclusion. In addition, Linklater and Swaisgood (2008) found that the risk of post-release death was more closely related to recipient reserve size and release density rather than the interaction of sex and age and presence of resident conspecifics. They state that reserves larger than 115 sq km with rhino densities less than 0.11 rhino/sq km should be favoured for black rhino translocations. The new area of Ol Pejeta is 180 sq km with no resident conspecifics, giving a rhino density after translocation of 0.15 rhino/sq km, which more or less fits these parameters. However, the rhinos translocated from Solio had previously been living successfully at a density much higher (1.23 rhino/sq km) than that considered usual for black rhinos without fighting as would have been expected particularly between males (Patton et al. 2007). The high level of prior sociability exhibited by Solio rhinos and the extreme care taken in selecting the 27 candidates from the 85 available (Patton et al. 2008) could also have contributed to the success of the translocation irrespective of it being free release. The choice of candidates, especially in relation to prior knowledge of their sociability with other rhinos, from the donor population could be more critical to the success of a translocation than many other factors but has been rarely reported on.

Conclusion

Translocation has largely been applied successfully to black rhino meta-population management (Linklater 2003) but in almost all situations it has involved a degree of captive, boma, management. In addition, there has been little research into free release rhino translocation and on same day capture/release. There is great variation in the performance of individual rhinos after translocation and release (Hofmeyr et al. 1975; Hall-Martin and Penzhorn 1977; Hitchins 1984; Adcock et al. 1998; Brett 1998) while survival and post-release breeding after some translocations has been poor in ways that, according to Linklater et al. (2006), might relate to the characteristics of individual rhinos involved, how they were translocated and released, or the context into which they were released. The success of a translocation might be improved by a better understanding of how rhinos behave after release, particularly how much they move relative to their release site and their pattern of movement about the landscape during the early stages of establishing a home-range (Linklater et al. 2006).

In this paper we have described a method of translocation that has not been tried before in Kenya on such a scale. Its clear success in the first six months after release offers rhino managers pointers for an alternative approach to rhino translocation that could reduce potential problems. However, the unique black rhino social organization experienced by the translocated rhinos while in the donor reserve would not be considered 'typical' and will probably provide an additional benefit towards the resulting success of this translocation.

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