THE EFFECTS OF BOMA DESIGN ON STRESS-RELATED BEHAVIOUR IN JUVENILE TRANSLOCATED AFRICAN ELEPHANTS

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ABSTRACT

Translocated juvenile elephants are generally kept in a boma so that they may adapt to the new environment and form bonds with group members before being released. Research on five different groups showed that high frequencies of aggressive behaviour can be expected, particularly in a confined space and with restricted food. Small pens with restricted view to the outside tend to induce nervousness. Nervousness decreases after the introduction of an adult female. Very young individuals may display aberrant behaviour. Older juveniles and adults seem to be most affected by confinement. It is suggested that food be dispersed so that weaker individuals have a better chance to feed. One or two open large paddocks with an electrified fence is recommended, instead of a closed wooden pen and paddock.

INTRODUCTION

Juvenile elephants originating from the Kruger National Park are usually kept in a boma for a certain period of time after translocation so that they may adjust to the new environment and form bonds with their new group members. The time the juveniles are kept in a boma depends on the availability of food outside, age and condition of the elephants, and also on management. Same sized juveniles are generally penned together and probably do not come from the same family unit. There is still much controversy as to how a boma at the new site should be constructed. The aim of this paper is to document various stress-related behaviours observed in translocated juvenile elephants and from these data make recommendations as to how bomas should be constructed in order to minimize stress in these elephants.

MATERIALS AND METHODS

There were two main study areas in the northern Transvaal, Spektakel Game Ranch which is 7,000ha, and the Venetia Limpopo Nature Reserve, an area of 20,000ha. Additional information was obtained at Madikwe Game Reserve comprising 60,000ha in Bophuthatswana, and by interviewing owners of translocated elephants.

Spektakel Game Ranch, N.Transvaal

Six juvenile elephants (three males, three females) aged approximately between two to four years were introduced into the boma in July 1991.

The boma consisted of a smaller pen and a larger paddock. The pen was 30m x 50m and had steel poles set about 30cm apart and horizontal cables. The feeding troughs were placed along one side about 3m apart. The elephants were fed and kept in here for five weeks. Then they were released into a 4.5ha paddock which had a large dam. The fence was made of welded mesh and had five horizontal strands of electric wires. Although the pen was always accessible to the elephants they only entered it for feeding and then left immediately. They spent six months in the boma and were observed from the beginning of September 1991 up to their release into the reserve in early January 1992.

Venetia Limpopo Nature Reserve, N. Transvaal

Four groups of juveniles were introduced into the boma during the same season as follows, but they were kept in different pens:

Group		Approx. age	Arrival
A: 0 males	4 females	6.0 - 7.0 yrs	21 5 1992
B: 3 males	5 females	3.5 - 4.5 yrs	28 5 1992
C: 5 males	0 females	2.5 - 3.5 yrs	26 6 1992
D: 5 males	0 females	1.8 - 2.5 yrs	28 6 1992

The boma was subdivided into four pens, each 25m x 25m. The feeding troughs were placed along one side about 3m apart. The fences between the four adjoining pens consisted of horizontal and vertical wooden poles

set 0.5m apart. A l.5ha paddock joined onto two of the pens which each had a separate gate. There was a mud wallow available. The paddock fence was mesh and had three horizontal electric wires. The animals were kept in the boma until mid-August when they were released into the reserve (excluding group D). The groups A and B adjacent to the paddock were allowed into this on alternating days. The semi-tame 19-year-old female, Jane, originating from Zimbabwe, was introduced on 7 July 1992 and penned with group C for one week, then with groups C and B together until they were released. These four groups were observed throughout their boma stay.

Madikwe Game Reserve

Family units of 194 elephants of all ages were caught in Gonarezhou Game Reserve in Zimbabwe and translocated in groups of 5 to 15 to Madikwe Game Reserve in Bophuthatswana during August - October 1993.

Four days were spent at the boma with the last group of 23 elephants comprising three to four family units and four adult males. This group was kept in the boma two days longer than the others so that the observer could habituate them and identify individuals for subsequent research after the release. No sampling was done. A section with four strongly built pens was present. Each pen was I 8m x 1 8m and each side had six vertical steel poles with wooden poles inbetween (about 1 5cm space between the poles), reinforced by two horizontal steel poles. The first groups of translocated elephants showed extreme aggression when confined in these pens. Subsequent elephant groups were therefore kept in the 3ha electrified paddock only, prior to being released into the reserve. The fence was 15cm x 10cm wire mesh, with steel poles set about 4.5m apart, reinforced with a horizontal steel pole. There were three electric strands.

METHODS

Observations were done on a daily basis. The elephants eventually became habituated to the observer walking and sitting around the fence of the boma.

At Spektakel all occurring interactions were recorded. At Venetia each group was observed separately. Due to the construction of the adjoining fences between the pens, the elephants could interact through these with the other groups. All occurring interactions within a given group and any interactions at the fence between the focal group and any other group were recorded.

The following elements were classed as a) aggressive behaviour: any form of obvious pushing, hitting with the trunk, kicking or chasing a partner; b) affiliated behaviour: touching or smelling any part of a partner's body with the trunk tip, leaning or rubbing against a partner (Garai, 1992); c) play behaviour: sparring bouts, playing in the water, climbing on a recumbent partner.

Group A at Venetia, a seemingly highly stressed group, gave me the opportunity to analyze and define arousal behaviour. The following elements were defined as arousal: ears up, head held high and tail held up horizontally; aggression; walking away from a stimulus; running; loud vocalizations; running into a "cluster formation"; temporal gland secretion. Arousal behaviour was recorded as I (occurred) or 0 (did not occur) in thirty second (30s) intervals. This is known as the one-zero method (Altmann, 1974).

Translocated Elephant Information Centre (TEIC)

The TEIC was established over a year ago. A three-page questionnaire was sent to 25 owners (or managers) of translocated elephants. Twenty of these owners were personally interviewed. The questions related to a) the boma: construction, hygiene, time kept in boma, contact with humans; b) behaviour of elephants: in the boma, diseases, behaviour after release, utilization of habitat; c) personal opinions: reasons for acquiring elephants, what would be done if there were too many elephants on the property? what would be done differently a second time?

RESULTS

Spektakel Game Ranch

Interactions

Once the elephants had habituated to the observer walking around outside the fence, they seemed at ease. Out of the combined total of 2,275 affilliated and aggressive behaviour elements, 56.1% were aggressive, except during feeding time when one of the females was bullied and prevented from feeding by the others. She had to be fed and guarded separately, mainly by the observer. This female was the recipient of most aggressive behaviour by all others at any time and was never aggressive herself. One of the males displayed most of the aggressive

behaviour. The three males, and particularly one of the females, had frequent sparring bouts with each other. The elephants also enjoyed playing in the water together. However the female that was bullied was frightened to enter the water with the others and often stood at the edge of the dam, or else she played on her own. Frequent play was seen when the elephants had a "sand bath", then they would roll in the sand heap and climb on top of each other.

The six elephants were always in a group, seldom more than 10m apart. Only once when they panicked. after a truck drove past, a female split from the group and stayed alone for half an hour. She appeared to be looking for the others.

Venetia Limpopo Nature Reserve

Interactions

All four groups were more aggressive than affiliated within each group. Groups A and C which displayed much intragroup aggressive behaviour showed more affiliated behaviour to non-group members than to their own group members (Table 1). It is interesting that group B had much the same percentage of aggressive behaviour as the group at Spektakel, both being composed of a mixed sex ratio. There was hardly any aggression at the fences. Aggression could be seen at any time, but especially during feeding time, when weaker individuals could hardly get to the troughs. In group D the youngest individual had to be fed separately and guarded during feeding time the first week until he learned to eat faster and fend for himself. In group B one female hardly ever got to the feeding trough for the pellets, but she was able to feed on the lucerne and branches which were dispersed.

Abnormal behaviour

Group D consisted of very young juveniles which would still have been suckling in a normal family unit. The youngest individual (probably less than 2 years), who received most aggression from others, repeatedly "suckled", or "attempted to suckle", at the ear pinna of another group member (36.1% of all his interactions with a partner were "suckling" and 44.3% attempted "suckling"). When prevented from suckling he emitted rumbles, growls and frustration screams with a frequency of one vocalization in every four minutes. This individual subsequently died after another translocation to Natal, three months after having arrived at Venetia. His "suckling partner" seemed to have learned this aberrant behaviour, which he in turn displayed at another locality after also being translocated again at the same time (Jim Stockley, pers.comm.).

Arousal behaviour

The oldest individuals, Group A, were extremely nervous throughout the boma stay, and one individual was particularly aggressive towards humans near the fence. There was also much aggression between

Table 1. Aggressive and affiliated behaviour for the four groups of elephants at the Venetia Limpopo Nature Reserve.

	Aggressive behaviour	**Affiliated behaviour**	**Affiliated behaviour**	
			intragroup	**intergroup**
Group A	80.3%	19.7%	38.7%	62.5%
Group B	56.6%	43.4%	78.2%	21.8%
Group C	90.9%	9.1%	33.3%	66.7%
Group D	60.7%	39.3%	75.9%	24.1%

Column 1: Groups A to D (see methods for group definitions);
Columns 2 and 3: aggressive and affiliated behaviour respectively in percent of combined aggressive and affiliated behaviour within a group;
Columns 4 and 5: affiliated behaviour within a given group (intra group) and between different groups at the fence (intergroup) in percent of total affiliated behaviour.

No play behaviour could be seen in groups A, C or D. Only in group B the three males and one of the females had occasional sparring bouts. They were never seen playing at the mudwallow.

Table 2. Frequency of interactions between partners per time for five different groups of elephants.

GROUP	No ELE	N	GR FR/hr	x/IND
Spektakel	3m, 3f	5696	53.2	8.9
venetia A	0m, 4f	711	12.5	3.1
Venetia B	3m, 5f	1633	35.2	4.4
Venetia C	5m, Of	68	6.2	1.2
Venetia D	5m, Of	798	29.6	5.9

No ELE = number of elephants; N = total interactions;
GR FR/hr = group interacting frequency per hour;
X/IND = average interacting frequency per individual per hour.

individuals, especially from one female which constantly pushed the others, but at the same time was always within touching distance of one of the others. Another female seemed particularly nervous, showing most signs of arousal among the four individuals. She secreted daily from the temporal gland. whereas the others only did so occasionally, when frightened by something. The frequency of temporal gland secretion appears to be individual (Garai, in prep.). All females calmed down after the release.

However, all groups showed nervousness or aggression towards alien stimuli *(e.g.* people, strange noises). There was overall a significant decrease (McNemar test onesided, $p<0.005$) in arousal behaviour after the arrival of the adult Jane (see Figure), even by those groups not in the same pen as Jane.

Frequency of interactions per time

The six elephants in the large boma at Spektakel showed most interacting frequency per time (Table 2). This group also showed much play behaviour and appeared at ease. At Venetia, groups A and C showed a very low interacting frequency and most interactions were aggressive (50.9% of total interactions for group A; 58.8% of total interactions for group C).

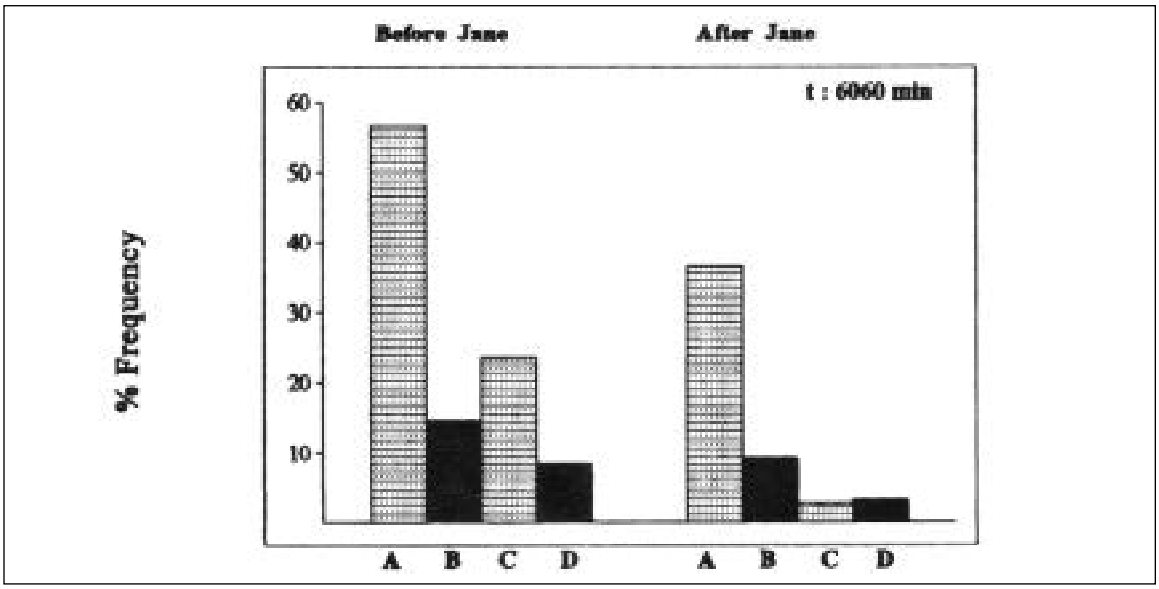
Madikwe Game Reserve, Bophuthatswana

The first groups of family units translocated to Madikwe Game Reserve showed extreme aggression and nervousness when confined in the pen, and one elephant broke out, demolishing the steel gate in the process. The subsequent groups were therefore kept only in the large electrified paddock and released into the reserve within two days after arrival. This procedure seemed less stressful to the animals. They were calmer and not aggressive in the paddock and respected the electric fence. Even during feeding time no aggression was seen during the four days spent at the boma. The family groups appeared to wait for their turn at the feed. These elephants probably knew each other from Gonarezhou.

Translocated Elephant Information Centre - TEIC

Aggressive behaviour in the boma was reported by nearly everyone interviewed (83.2%, n=25). In a number of cases the weakest and most bullied elephant had to be separated, especially during feeding time. It was unanimously stated that the elephants immediately learned to respect the electric fence, and that it was unnecessary, even dangerous, to electrify the pen.

Four ranches visited did not have a pen at all, but kept the elephants in a large electrified paddock only. The fence of this was much the same as the periphery fence of the reserve, only slightly reinforced with cable. At Mokolo River Nature Reserve there were two paddocks, a smaller one (0.5ha) with a fence consisting of horizontal steel cables and vertical wooden poles, and a larger paddock (2ha) with a game fence reinforced with steel cables. There were two electric wires. The small paddock had a rivulet flowing through it.



Percent of samples in which arousal behaviour occurred during preceding thirty second intervals in groups A to D at the Venetia Limpopo Nature Reserve before and after the introduction of the tame adult female Jane.

Once the juveniles had calmed down in the smaller paddock, they were given access to the larger paddock and they never went back into the smaller one, although the connecting gate was kept open. Keeping the juveniles in a paddock only was considered to have a positive effect on aggression and nervousness by all owners concerned. Everyone stated that the elephants were nervous of humans after the release and that they kept to the most secluded parts of the reserve. Only where the elephants had been habituated to one person and were constantly monitored after release were the people able to see their elephants regularly.

DISCUSSION

Aggressive behaviour was seen in all groups of juvenile elephants in a boma. There appear to be various causes for this. Aggression became most apparent during feeding time when certain individuals were pushed away from the feeding troughs. Restricted food seems to induce competition amongst individuals. It is interesting that there was so little intergroup aggression at the adjoining fences at Venetia, suggesting that the individuals realized that there was no food competition to fear from the other groups.

The fact that there was no aggression in the family units at Madikwe could either indicate that there isless aggression in a group when adults are present or else, assuming these elephants from Gonarezhou knew each other, they had established a dominance hierarchy. In a normal family unit dominance rank appears to be based on age, but there also exists rank order between family units (Moss, 1988). In a new group each individual has to assess its position in relation to the others (Kummer, 1975), and a rank order will be established.

Research at the Kruger National Park has shown that newly captured juvenile elephants develop extreme signs of stress when confined within walls (Hall-Martin 1992). Therefore a closed pen should have much the same effect. Aggression could also be a reaction to nervousness, as appeared to be the case in the one female of group A at Venetia, who constantly pushed the others yet kept close to them. In addition, in a pen the natural flight distance to a person approaching cannot be maintained, a fact which will most likely enhance the feeling of being "closed in". Group A reacted strongly to humans around the boma, either with aggression or else "clustered" at the back of the pen. Given the opportunity, they would probably have chosen a greater flight distance.

Group A elephants were the oldest and the most nervous. They calmed down after they had been released. The youngest individuals, group D, were the least nervous. Very young animals may habituate faster to humans and a new situation. The significant

decrease in arousal behaviour after the introduction of the adult female shows that juveniles feel less nervous when an adult is present, even if she is not the mother and not in the same pen.

Display of play behaviour is probably an indication that animals feel at ease and therefore the elephants at Spektakel were the most relaxed of all groups. This could be due to the large paddock.

In cases where the elephants had a choice between a pen and a paddock (Spektakel) or between a small and a large paddock (Mokolo), they chose the larger of the two. Furthermore, in their questionnaire responses, the owners indicated that elephants confined to a paddock without a pen were less stressed.

CONCLUSIONS AND IMPLICATIONS TO MANAGEMENT

- Translocated juvenile elephants will tend to show aggression during the boma stay. This will be apparent especially where food is restricted, or placed too close together (i.e. within reaching distance of a neighbour). It is suggested that food be abundant and dispersed at several sites to allow weaker individuals access to it.

- Small or weak elephants will most likely be bullied. It is therefore not advisable to put different sizes of animals together, unless they are related.

- Introduction of an adult female to a group of juveniles has a positive effect.

- Certain, especially older, individuals seem to react badly to confinement and should not be kept in the boma long.

- Young elephants under two years of age should not be translocated without mothers.

- If one wishes to have a pen, it should be constructed in such a way that the animals can see through the fence. However, keeping the elephants only in a paddock appears adequate. This will probably be less stressful to them, cheaper to build and will still serve the purpose of allowing the animals to adapt to the new environment and form bonds within the group.

- A large paddock with a normal electrified fence (reinforced with steel cable) is suggested. This will provide the elephants with security without feeling "confined" and allow them to become familiar with the electric fence. The size of the paddock will depend on the number of elephants, but an area of 3ha is considered to be an acceptable minimum. If the elephants are very young it is advisable to keep them in a small paddock until they calm down, then give them access to a larger paddock.

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