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## Genetic Kinship and Social Structure in White Rhinos at the Zoological Center Tel Aviv Ramat Gan (Safari)

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The decline in reproductive rate of rhinos in zoos around the world, including in the F1 generation has been identified as a major concern affecting the future wellbeing of these herds. The major factors, which may contribute to reproductive decline, include ageing, behavioural- incompatibility of individual males and females, behavioural incompetence, genetic- inbreeding depression, hormonal or reproductive tract dysfunction or dietary aspects. (Patton et al 1998).

The Zoological Center Tel Aviv Ramat Gan (Safari) is now grappling with this problem in its herd of white rhinos.

The white rhino herd at the Safari in Ramat Gan originated as a group of 4.4 imported from South Africa to Israel in 1973 at the estimated age of two –three years. Between 1978-1996, 20 rhinos were born in the park. Births ceased in 1996, although copulations continue. The herd structure currently consists of 5 males and 6 females of which four males and 3 females were born in the park. The rhinos in the Safari are managed as a free-ranging multi-male herd on an area of about 0.7 km<sup>2</sup>. The animals are not separated at any time; therefore paternity cannot be known with certainty from behavioural observations.

This study sets out to determine the genetic parentage and establish the current social behaviour of the population. It is part of a larger study to analyze the associated with reproductive decline to help make intelligent management decisions for white rhinos in the safari park.

### Methods

#### Molecular analysis

Genomic DNA was extracted from hair follicles as described by Ausabel (1987) with some modifications. Primers were obtained from UBC (University of British Columbia Biotechnology Lab) Primer Synthesis Project, set 100/4 and 100/2 for PCR amplification.

#### RAPD procedure

The accepted criterion for ascribing paternity to a male candidate is at least 3 bands of the RAPD pattern (using three different primers) are found in the pattern of the male but not in the mother's (Neveau et al 1996).

## Behavioural observations

We concentrated on four major parameters:

1. Spatial distribution of rhinos – location in one of 4 arbitrarily defined areas
2. Social preferences of the herd- measured as less than 10 m apart
3. Dominance of males as determined by displacement of other males, backward kicking at scent marking stations
4. Events surrounding courtship and copulation

Observations were in the form of spot checks, with the exception of copulatory events. A total of 212 h of observations were made over a 2.5-year period

## Results

### Paternity determination

A sample gel for the rhino Atari, using primer UBC 332 is shown in Fig 1. A band, which does not appear in the PCR products of his mother, is identified in the PCR products of the male Rafi. Two other primers gave the same results; thus we determined that Rafi is Atari's father.

The young born in the Safari and the ascribed paternity using RAPD is shown in Table 1. One male (Rafi) fathered 3 calves over a period of 15 years, and two other males each fathered one calf. The paternity of two other animals was not identified- the father may be dead or is no longer in the Safari. The paternity of a third individual could not be identified because DNA was not available from the mother.

### Behavioural results

#### Spatial distribution

The observations showed that four females spent most of their time in area B while two others divided their time equally between area B and D. (Fig 2). Two males spent most of their time in the vicinity of the four females while three others were seen almost exclusively in area D. (Fig 3A).

Following separation of the dominant male Shalom from the herd, the spatial distribution of the females remained unchanged, but that of two males (Atari and Zion) shifted to the area occupied by most of the females (area B) (Fig 3B).

#### Dominance

The male Shalom was determined to be dominant by first access and displacement of other males when females were in oestrus and by kicking activity around the dung heaps.

#### Copulatory events

The dominant male Shalom was found to be unable to achieve an intromission (see photo at top). During copulation other males appeared to stand by or actively interfere with copulation.

One nonfertile founder female formed a bond with a young potentially fertile female, and physically blocked male courtship toward her, effectively preventing her from copulating.

#### Social preferences

The social preferences of females were stable throughout the observation period. Male aggression increased for several months following the separation of the dominant

male „Shalom“. The male who interacted least with other individuals was the founder male and the father of three calves. Preferences of males to be in vicinity of females was significantly greater than to be in vicinity of males (Fig 4).

## Conclusions

RAPD proved to be a useful technique for determining paternity in the white rhinoceros. It showed that one male fathered 3 young over a 15 year period, during which other males fathered young as well.

The behavioural observations indicated that males as well as females might interfere with each other during copulation. The management outcome has been to pen up one male. However, even though this male has been penned separately for 18 months, no female has become pregnant.

Our next step will be to examine reproductive function of females and males using ultrasound and electroejaculation.

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