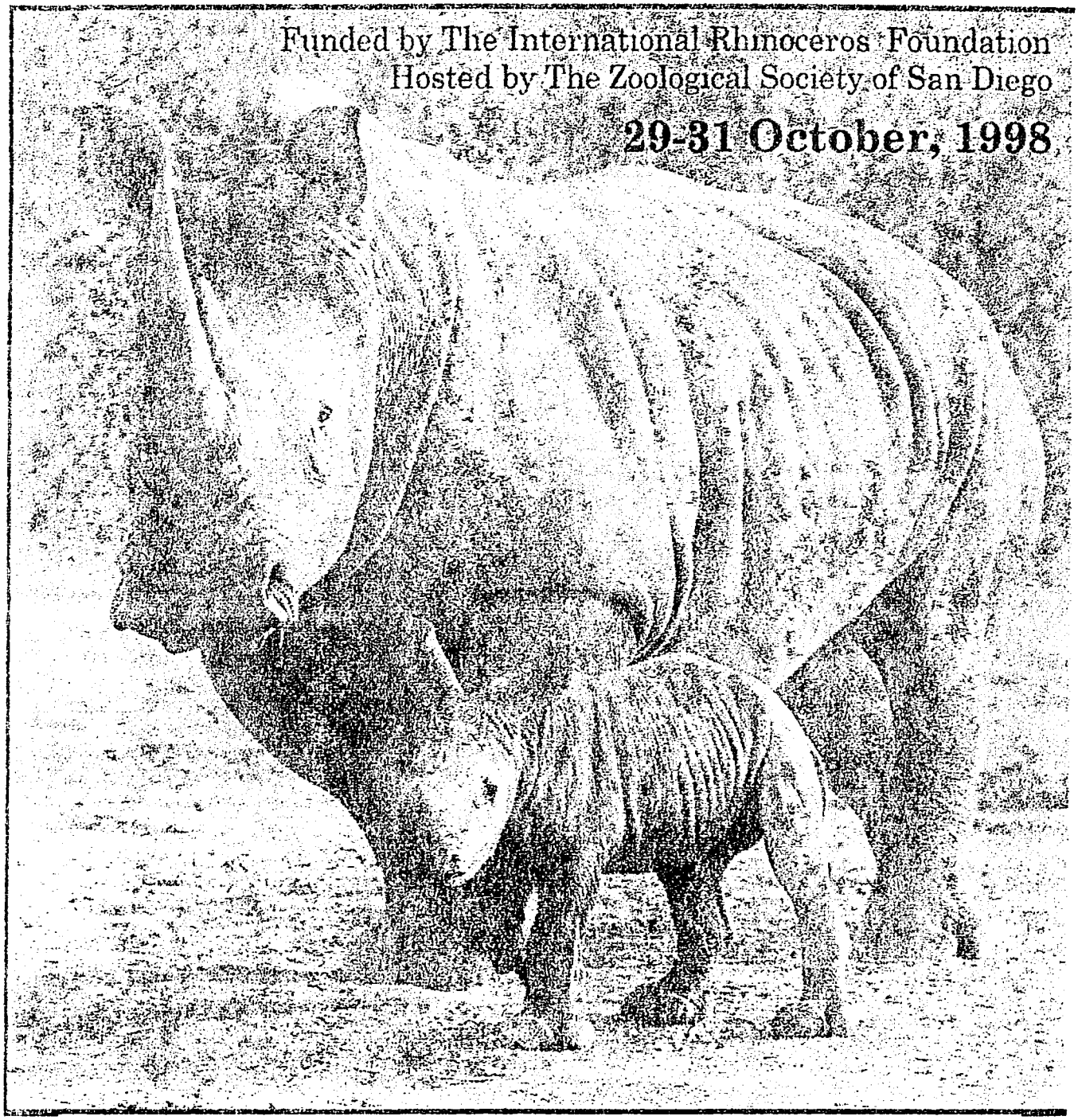
Workshop on Problems Associated With the Low Rate of Reproduction Among Captive-born Female Southern White Rhinoceros *(Ceratotherium simum simum)*



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29-31 October, 1998

Organized by: Lynn Patton, Nancy Czekala and Valentine Lance

Center for Reproduction of Endangered Species
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Proposed Agenda for a Workshop on Problems Associated With the Low Rate of Reproduction Among Captive-born Female Southern White Rhinoceros (*Ceratotherium simum simum*)

October 29, 1998: Thursday

Location: Treetops

8:00 -8:30 Arrival and Breakfast

8:30-8:45 Welcome — Val Lance, Nancy Czekala

8:45-10:15 Introductions

Each participant will present a 3-min. introduction of him/herself, research interests, and background relating to the focus of the workshop.

10:15 -10:30 Break

10:30- 11:30

Overview of the Problem: History and Background — Randy Rieches, Elliot Handrus

11:30-12:30 Lunch

12: 45 The group will be driven to the San Diego Wild Animal Park

1:45-3:45 Attendees will visit the rhinoceros at the Wild Animal Park in order to have a better understanding of captive husbandry and the problems that may be associated with management

October 30, 1998: Friday

Location: Treetops

8:00 -8:30 Arrival and Breakfast

8:30-10:30 Tutorial 1 and 2

Note: each tutorial will be followed by a question and answer period.

1. Tutorial:	The North American Experience Female Hormonal Cycles	Terri Roth
2. Tutorial:	The European Experience Female Hormonal Cycles	Franz Schwarzenberger

10:30-10:45 Break

10:45-11:45 Tutorial 3

3. Tutorial:	Induction of Ovulation	Lynn Patton Terri Roth

Meeting moves to Rondavel

12:00-1:00 Lunch

1:00- 3:00 Tutorial 4-5

4. Tutorial:	Ultrasound Studies Clinical Problems	Robin Radcliffe
5. Tutorial:	Observations of behavior and reproduction in the wild	Norman Owen-Smith

3:00-3:15 Break

3:15-5:30 Tutorial 6-8

6. Tutorial:	An evaluation of behavioral mechanisms of reproductive failure in captive born southern white rhinoceros	Ron Swaisgood
7. Tutorial:	Management of a group of southern white rhinos	Terry Wolf
8. Tutorial:	Information from other rhino species - is it relevant?	Ian Gunn

October 31, 1998: Saturday

Place: Rondavel

8:00 -8:30	Arrival and Breakfast
12:00	Lunch

Round Table Discussions and Protocol Synthesis

Identify and prioritize problems.

Discuss potential avenues for treatments and future research

Summary and Conclusion

Al Conley
Barry Ball

Concerns With Breeding F1 White Rhinoceros In Zoological Institutions

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From its first exhibition in the Pretoria Zoo in 1946 until 1994, there has been the following statistical information recorded for the white rhinoceros:

Southern White Rhinoceros (*Ceratotherium simum simum*)
Imports = 256.347.2 = 605 (The first import was an animal at the Pretoria Zoo, July 29th 1946)
Births = 253.217.5 = 475

Northern White Rhinoceros (*Ceratotherium simum cottoni*)
Imports = 9.12 = 21 (The first import was a pair at the Antwerp Zoo in April of 1950)
Births = 1.3 = 4

The first recorded captive birth of a Southern White Rhinoceros was on June 8th, 1967 at the Pretoria Zoo. Of the 253.217.5 = 475 specimens born in captivity, 19.13.3 = 35 were stillbirths.

Captive longevity for a Southern White Rhinoceros male was set at the SDWAP with 35 years, 6 months.
Female longevity was set by an animal in Pretoria at 40 years, 8 months.

Recorded average gestation for the white rhinoceros is 514 days. (480 - 548)

The age of captive born female whites at first parturition has been recorded at 4 years 4 months and 4 years 11 months.

Female Ujima born 26 Feb. 1995 at the SDWAP - ISIS 695051 - SB #1051 will be the exception to this average as she is pregnant and is due April 1999.

Regarding the male at the birth of their first offspring (not at the time of mating), the time frame is 3 years 2 months and 4 years 4 months.

The shortest interval in days between captive births is 409, 451, 469, and 506.

Continent	Number of births	Year of first birth	Country
Africa	32	1967	South Africa
Asia	68	1978	Japan
Australia	6	1981	Australia
Europe	128	1971	Germany
No. America	228	1972	USA
So./Ce. America	19	1976	Mexico

The North American SSP population consists of 55.67 = 122 animals in 38 institutions, with 1.1 births and 2.2 deaths in 1998. (September)

In the SSP population the top 15 ranking males and top 30 ranking females have no living offspring in the United States. We have been able to reproduce founder Southern White Rhinoceros with some degree of regularity in both Europe and the US. Although some of the male and female founder population has not reproduced offspring, we believe that the major reason for this can be attributed to the historical management practice of keeping animals in pairs.

Of major concern now is the F1 population of animals in zoos worldwide. With an aged population of founders and the impending imports of new founders, the need to deal with F1's has never been more critical. We can not afford to make the same mistakes that we have inadvertently made with the white population in the past. It is believed that only 8% of the F1 population worldwide has reproduced.

The Southern White Rhinoceros collection at the San Diego Wild Animal Park has produced 43.42 = 85 offspring.

Historically there have only been three female F1's that have had the opportunity to reproduce at the SDWAP, one of which is currently pregnant.

Note: Statistical information from the Zoological Society of San Diego, the International Studbook and The Rhinoceros in Captivity by L. C. Rookmaaker 1998

Assumed Problems In The Reproduction Of F1 White Rhinoceros:

* Animals that are not cycling or appear not to be cycling
* Animals that do cycle and breed but fail to conceive
* Females that do not have the opportunity to breed
* Suppression of F1's by their dams
* Suppression of F1's by higher ranking females in the group
* Mate preference
* Medical cause
* Environmental factors

The North American Experience: Female Hormonal Cycles in Southern White Rhinoceros

Terri Roth[1], Lynn Patton[2], Janine Brown[3], Nancy Czekala[2], Ron Swaisgood[2] and Valentine Lance[2]

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Our understanding of the reproductive biology of the southern white rhinoceros is at best fragmentary. There is still disagreement, for example, on the length of the reproductive cycle. Hindle and coworkers (1992) report a 32-day cycle based on urinary hormone analysis of total oestrogen and 20 α-dihydroxy-progesterone from one animal. Combined serial ultrasonographic evaluations and faecal pregnane analysis of a single female showed two non-conceptive cycles of 31 and 35 days (Radcliffe *et al.*, 1997). In contrast, a recent study of 16 southern white rhinoceroses led researchers to suggest a 10-week cycle based on faecal pregnanes (Schwarzenberger *et al.*, in press), whereas Wagner (1986) suggests cycle lengths to vary from 38 to 58 days based on urinary hormone analysis, vaginal cytology and rectal examination. Behavioural observations in the wild (Owen-Smith, 1973, 1975) indicate a cycle period of approximately 30 days. Similarly, a multi-institutional survey (Lindemann, 1982) provided evidence for cycle length to vary by multiples of about 30 days.

There are several reasons for the paucity of endocrine data for southern white rhinoceros. Sample collection in group-housed animals is difficult because defecation and urination must be observed to insure accurate sample identification, a task made more difficult by the rhinoceroses' habit of defecating in communal dung heaps. Another problem is that many of the reproductively active females are pregnant most of the time and do not often exhibit non-conceptive cycles, while the remaining animals available for study are often non-reproductive and may exhibit erratic cycles or none at all (Schwarzenberger *et al.*, in press). Consequently, research in this area suffers from small sample size and lack of data representative of normal reproductive patterns.

In this brief review, we present data from hormonal faecal analyses of 27 female rhinoceros maintained at 12 institutions in North America. At least three samples/week were collected from each female over a period of at least 10 months. Samples were analyzed for progesterone metabolites using a monoclonal antibody that has broad cross reactivity to a number of pregnanes.

We applied both behavioural and endocrine data to characterize cycle length. At least 12 out of the 27 females examined showed no hormonal evidence of reproductive cycles. In these animals pregnane concentrations in the feces remained at baseline. Two females became pregnant shortly after giving birth and thus did not reveal any non-conceptive cycles. The remainder of the rhinos exhibited erratic cycles, cycles of approximately 30 days or cycles of approximately 70 days. Some animals went through both 30 and 70 day cycles.

A few females exhibited unambiguous cyclic patterns of pregnane excretion in the feces, suggesting ovulatory cycles. Many animals, however, had erratic cycles that did not give a clear indication of ovulation, and many animals remained acyclic. Consequently, our data suggest that during the course of several cumulative non-pregnant rhinoceros years, few reproductive cycles occurred. Schwarzenberger and coworkers (in press) monitored pregnane

levels in several females and found endocrine patterns strikingly similar to ours, with the majority of females demonstrating acyclic or irregular cycles.

These studies suggest that lack of regular ovarian activity is a prevalent cause of reproductive failure in most captive southern white rhinoceros (Table 1). Despite periods of erratic and acyclic ovarian activity observed in many females, other females exhibited two clear patterns of reproductive cycle. The first pattern (Type I cycle) suggests a typical reproductive cycle length of 35.0 ± 2.1 days. This finding is consistent with previous physiological and behavioural research supporting a cycle length of approximately one month (Owen-Smith, 1973, 1975; Lindemann, 1982; Hindle *et al.*, 1992; Radcliffe *et al.*, 1997). Our endocrine and behavioural data revealed that a significant proportion of reproductively animals showed a cycle of between 29 and 41 days. The second pattern (Type II cycle) is characterized by an extended luteal phase and lasts approximately 70 days (Schwarzenberger, *et al.*, in press).

Further corroboration of our argument for a typical cycle of approximately one month is found in the observation that one female conceived at the end of three cycles, each about one month in duration. In addition, a recent study of a single southern white rhinoceros female documented two circa 30-day ovulatory non-conceptive cycles, confirmed with ultrasonography (Radcliffe, *et al.*, 1997). Conception followed the second cycle. Clearly, cycles followed by confirmed ovulation and/or conception are more likely to represent "normal" (i.e., fertile) reproductive cycles.

Although more than half of our data indicate cycles of approximately one month, a large number were of the Type II. The frequent occurrence of extended luteal phases found in both of these studies could be attributed to several factors. Radcliffe and coworkers (1997) used ultrasonography to document two conceptions followed by embryonic loss approximately one month post-conception. In both cases, pregnane values remained elevated for 70-80 days post conception, producing an endocrine profile remarkably similar to those observed in this and Schwarzenberger and colleagues' (in press) study. This phenomenon appears independent of breeding activity since females that are breeding and many that are not exhibit similar extended cycles. The frequency of these extended luteal phase cycles suggests that a physiological mechanism is involved and is occurring with some consistency among the captive female white rhino population.

Our conclusion is that the captive white rhino is exhibiting two primary types of reproductive cyclicity. Type I cycles are ~30 days and appear to be fertile cycles. Type II cycles are 60-70 days and are likely to be infertile cycles.

The challenge ahead for scientists and rhinoceros managers is to determine why a significant portion of animals are exhibiting these extended reproductive cycles and what we can do to overcome what appears to be an unusual infertility problem.

References

Hindle JE, Mostl E and Hodges JK (1992) Measurement of urinary oestrogens and 20α-dihydroprogesterone during ovarian cycle of black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinoceroses *Journal of Reproduction and Fertility* 94 237-249

Lindemann H (1982) African rhinoceros in captivity. MSc. Thesis, University of Copenhagen, Denmark. 1982

Owen-Smith RN (1973) The behavioral ecology of the white rhinoceros. Ph.D. Dissertation. University of Wisconsin.

Owen-Smith RN (1975) The social ethology of the white rhinoceros *Ceratotherium simum* (Burchell 1817) *Zeitschrift für die Tierpsychologie* 38 337-384

Radcliffe RW, Czekala NM and Osofsky SA (1997) Combined serial ultrasonography and fecal progestin analysis for reproductive evaluation of the female white rhinoceros (*Ceratotherium simum simum*): preliminary results *Zoo Biology* 16 445-456

Schwarzenberger F, Walzer C, Tomasova K, Vahala J, Meister J, Goodrowe KL, Zima J, Straub G and Lynch M (in press) Faecal progesterone metabolite analysis for non-invasive monitoring of reproductive function in the white rhinoceros (*Ceratotherium simum*) In *Animal Reproduction Science* Ed JL Brown and D Wildt

Wagner RA (1986) Monitoring the reproductive cycle of one southern white rhinoceros. In *Proceedings for the American Zoological Veterinarian* pp. 14-15 Eds. MS Silberman and SD Silberman, Chicago

Table I. FECAL HORMONAL PATTERNS IN CAPTIVE WHITE RHINOS.

Reproductive Category	TYPE I CYCLES*	TYPE II CYCLES*	TYPE I and II CYCLES	PREGNANT	ACYCLIC
Number of Rhinos	3	5	4	4	12
Number of Rhinos That Breed	1**	2	4**	4	
Age Range (Yrs)	3 to 20	26 to 28	7 to 35	3 to 30	12 to 35

* some animals represented in these numbers are not in a breeding situation
** one animals is also represented in the pregnant group