

**Reproductive assessment in the captive White rhinoceros - current standing**

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Endocrine monitoring of faecal hormones over the past years has identified some underlying problems for the long-standing breeding difficulties in the captive Southern White rhinoceros (*Ceratotherium simum simum*) (SCHWARZENBERGER et al., 1998, PATTON et al., 1999). Especially the low reproduction rate in the F 1 generation is of great concern. Based on this endocrine data acyclicity or erratic cycle activity with consequent mating failure was found in over 50% of the female EEP population. Variable oestrous cycle lengths of 35 or 70 days has been described, yet it was not determined whether one or both are physiological. Silent oestrus due to sibling relationship, conception and pregnancy failure due to presumed uterine pathology further demonstrate the multi-factorial character of the problem. In addition to the difficulties reported in females, it was not yet determined what role male sub- or infertility might play. Little emphasis has been put on the evaluation of male fertility. Considering that 81% of the male EEP population has not yet sired offspring (Ocas, 1999), reduced breeding fitness of males might be a contributing factor to the demographic crisis of the captive population.

Endocrinology provides fundamental and practical information for the reproductive management of the captive female. In addition to reported hormonal dysfunctions, it was widely assumed that animals managed ex situ develop reproductive pathologies which remain undetected by means of endocrinology. In the past ultrasonography has proven to be a valuable tool, mostly underutilized for the exploration of reproductive mechanisms and urogenital tract pathologies (HILDEBRANDT and GÖRITZ, 1998). Sporadic use of ultrasonography for reproductive health assessment in other rhinoceros species revealed long present pathologies not until late in their progression. Examples of observed reproductive pathologies include a high incidence of benign uterine muscle tumours (*leiomyomata*) in the Asian (HILDEBRANDT et al., 2001) and in the Sumatran rhinoceros (SCHAFFER et al., 1994). Regular ultrasound monitoring of the urogenital organs describe morphological changes during known reproductive events such as the oestrous cycle and pregnancy in the Sumatran and Black rhinoceros (ROTH et al., 2001, RADCLIFFE et al., 2001). Through these studies new knowledge was generated in regard to the functional interaction of the reproductive organs.

The broad application of reproductive ultrasound and electroejaculation for semen collection in over 50 individuals incorporated in an ongoing research effort elucidated further causes for reproductive failure in the White rhinoceros. In females ultrasound proved as a tool of utmost importance for the identification of:

- 1) reproductively sound potential breeders,
- 2) females with mild reproductive pathologies but remaining breeding potential, and
- 3) females with grave reproductive pathologies.

Uterine and ovarian pathologies were identified as additional severe problems contributing to the low reproduction rate. In addition to the summarised female problems, subfertility respectively infertility was present in a large number of the examined males. Some of the here described assessments were executed in restraint devices without the

use of drugs. However, due to the lack of such restraint devices and training programs in most zoological institutions, a standing sedation or full anaesthesia was required for most reproductive assessments for this European-wide research project. The development of a reliable anaesthesia and sedation protocols was an essential prerequisite for the generated information (Waizer et al., 2000).

In females pathologies such as uterine cysts, tumours (*leiomyoma*, *adenoma*), and para-ovarian tumour and polycystic ovaries and others, first occurring in mild stages at the age of fifteen, were imaged by ultrasound (Fig. 1-4). Uterine pathologies were identified in about 55% of the investigated females (n=30). Half of the animals was classified post reproductive due to the severity of pathologies, whereas the other half was considered fertile despite the presence of mild pathologies.

Fig. 1-4:

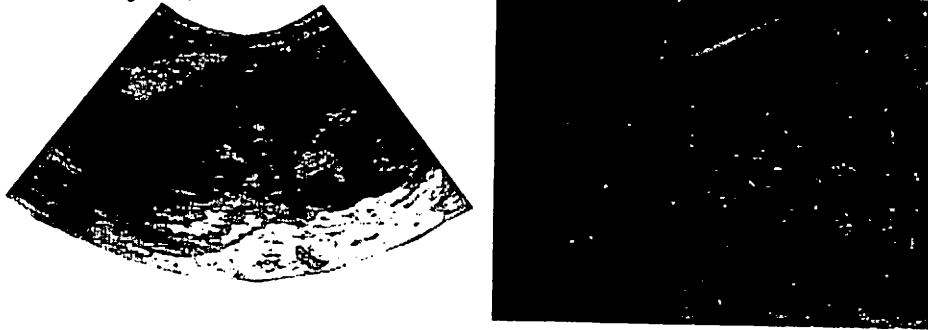


Fig. 1 + 2:  
Sonogram and post mortem preparation of endometrial cysts in the uterine horn.

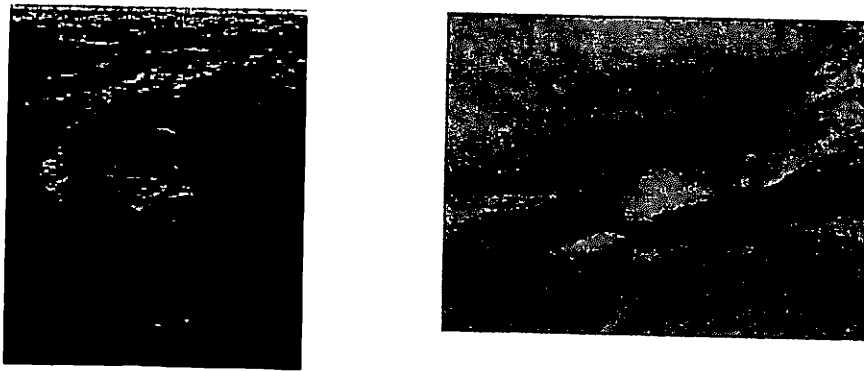


Fig. 3 + 4:  
Sonogram and post mortem preparation of uterine leiomyoma.

Ultrasound documented uterine pathologies regardless whether a female showed a regular oestrous or no cyclic activities at all, are independent from regular or missing oestrous cycle activities. The gravity of pathological changes stood in relation to the presumed number of lifetime non-conceptive cycles and to age. In contrast, females of advanced age which had one or a number of pregnancies showed remarkably few or no pathologies in their genital organs. In these females pregnancy and lactation seemed to have preserved the health and function of the reproductive organs. In the wild most females throughout their reproductive lifetime only have a small number of oestrous cycles. Considering inter-calving intervals of 4.5 to 6 years in the wild, pregnancy and lactation is the dominating endocrine event. In captivity pregnancy and lactation is a rather rare event.

Similar to other species as reported by HERMEL et al. (2000) and HILDEBRANDT et al. (2000), permanent oestrous cycle activities in the female White rhino without conception is regarded primary cause for the development of progressive genital pathologies. Supposedly chances for successful reproduction are reduced with the rising number of lifetime non-conceptive cycles and with age.

These findings show that sole endocrine monitoring and determination of a regular oestrous cycle in females older than 15 years does not yield enough information to consider an individual reproductively healthy.

In flatliner, non-existing cycle activities, ovarian cysts, persistent "micro" *corpora lutea*, or inactive ovaries were pinpointed to be responsible for the present infertility in females. According to these ultrasound specifications hormone therapies were developed which for the first time were applied to resolve specifically diagnosed ovarian dysfunction. Combined endocrine and sonographic follow-up examinations control the effect of treatments and the regression or progression of pathologies. This approach made it easier to evaluate and optimise hormonal therapies.

The systematic evaluation of male fertility by means of electroejaculation showed that the low reproductive performance of the captive White rhinoceros is not an one-sided female issue. In addition to female-related infertility, infertile or subfertile males with poor semen quality seems to pose an additional problem. Ejaculatory parameters assessed after electroejaculation, indicated that only 1/3 of the examined male rhino population was fertile, leaving all other potential breeders with subfertile or even infertile semen parameters behind.

When ultrasound assessed, in all male genital organs prior to semen collection an inactivity of the accessory sex glands was noted but no morphological causes were determined that could have been responsible for the subfertility or infertility. At this point it remains speculative what exact causes led to the reduced semen quality in most males and whether this status is reversible or progressive.

The management of large breeding groups with several males has been very successful. However, social stress induced by other dominant males or dominant female(s) may play a decisive role in the reproductive condition of an individual subdominant bull which at this point still needs to be determined through behavioural studies.

In conclusion, increased evaluation of the reproductive soundness of White rhino males and females may help to understand and overcome

long-standing problems in the breeding of this species in captivity.

Before making breeding recommendations it is of importance to assess the female/male reproductive status. Ultrasound combined with endocrine evaluations and behavioural assessments should form an imperative *trias* to determine potential female breeders, to identify causes of reproductive failure, and to develop mitigating treatments. In males this *trias* is formed by behavioural assessments, ultrasound, and semen evaluation.

It is proposed that prior to the translocation of an animal for breeding purpose a three step management scheme should be followed: monitoring, assessment, shipment. The chronology of this approach facilitates the evaluation of an individual's breeding potential and the effective use of available but limited resources. This approach aims to determine subfertile males or reproductively inactive females and/or non-proven breeders with healthy genital organs.

By implementing changes in management, or a new social environment reproductive activities could be resumed. Another aim is to avoid the relocation of post reproductive females or those with considerable pathologically changed genital organs to institutions with sound breeding capacities.

Serious injuries or mortal accidents have to be taken into consideration when applying this management strategy. The reproductive signalling of individuals might be influenced by the reproductive dysfunction afflicting aggressions in the new environment.

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