

One aim of this study is to show how far the artificial environments have an effect on the behaviour of the individuals especially on the occurrence of stereotypies. Therefore the behaviour of greater one-horned rhinoceroses in different housing systems was recorded and compared. It has to be checked whether animals kept with others show less stereotypies than solitary kept animals. Besides this it will be tested if there are differences between sexes and age classes. The group was divided into two age classes: subadults (females up to six, males up to eight years) and adults (older than six / eight, sexual mature). It is likely that the size and condition of the enclosure also have an effect on the behaviour.

This project is based on the observation of 16 (6.10) rhinos in six European zoos (Basel Zoo, Berlin Zoo, Berlin Tierpark Friedrichsfelde, Munich Tierpark Hellabrunn, Nuremberg Tiergarten, Whipsnade Wild Animal Park). 464 hours of observation were spread over five and a half month (May - October 1998). Two sampling methods were used to collect the data: focal animal sampling and scan sampling. All behaviour patterns were classified into 13 behaviour-categories so it was possible to determine the percentage of these categories in relation to the total activity of each individual. The behaviour-categories were described as lying down, standing, moving around, sniffing at objects, bathing, standing or walking in the water, feeding, grazing, browsing, playing, contact to others, stereotypies and other behaviours. All behaviour anomalies were summarised in one category because in most cases they occurred as stereotypies. The term stereotypy includes a wide range of different

movements. The majority of stereotypic movements recorded during the observation of the rhinos can be described as weaving (swinging the head and anterior parts of the body from side to side). In many cases weaving was accompanied with horn-rubbing. Another task was to find out if there are any sectors of the enclosure which are preferably used.

The investigations carried out in this study show that 11 out of 16 individuals have developed some form of stereotypy. In each zoo there is at least one animal which performs stereotypic behaviour. A significant difference between sexes does not seem to exist. The comparison of age-classes points out that the subadult individuals hardly show any behavioural disturbances but most of the adults spend a considerable time of the day with stereotypies. Moreover the rate of stereotypies increases during the afternoon. Furthermore it turned out that all solitary kept rhinos perform some kind of disturbed behaviour whereas rhinos kept in groups show less or no abnormal behaviour patterns. So it seems to be useful to keep rhinos in small groups in order to prevent the performance of stereotypies. But in this connection it must be mentioned that adult males probably can't be kept in a group without problems. Resulting from the investigation of the enclosure sectors preferred areas were usually feeding spots, ponds or wallows and places where most stereotypies were performed (very often in front of gates or doors). The occurrence of stereotypic behaviour does not seem to depend on the size but on the arrangement and furnishing of the enclosure.

## Quality and Digestibility of White Rhino Food - a Comparison of Field and experimental studies

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In this thesis concepts, approaches and methods of two disciplines of science, i.e. the veterinary medicine and biology, are united to investigate the relationships between nutrient intakes and digestive function, disease processes and behaviour of a herbivorous mammal, the white rhino.

Grass samples of the native rhinoceros food and samples of their excrements will be taken in the field study to analyse them for their nutrient composition and digestibility.

The second part of the thesis, the zoo study, will be based on these results. Only an interdisciplinary approach of nutritional science, traditionally based in veterinary science and foraging ecology based in zoology, can help to clarify these questions. Nutrition and digestive physiology are among the most important constraints on optimization of foraging, thus heavily influencing niche dimensions. Also they are among the most important factor for wildlife management and applied ecology.

There are some disease issues that may be associated with nutrition in rhinoceros. Götlenboth (1995) describes a disease in rhinos he compared with the equine pododermatitis diffusa and related it with too much intake of protein and energy. Also he reports on myopathia with myoglobinuria and associated it with overtax and too much intake of carbohydrates. There are also disease issues which are based on vitamin deficiencies.

Vitamin A deficiency can cause skin diseases, eye alterations and digestive dysfunctions. Many zoo animals have low blood values of vitamin E, even rhinoceroses. Götlenboth reported that average serum values of vitamin E for free ranging rhinos are 0.8-2.0 mg/l and these of animals in captivity are only 0.2-0.4 mg/l. Vitamin E deficiency can cause myopathia, general immune deficiency and is associated with the hemolytic anemia in black rhinoceros (Götlenboth, 1995).

In search for the optimal nutrient composition of white rhino food in captivity, the question arose which nutrient components and in what quantity are taken by wild rhinos.

94% of all white rhinos (*Ceratotherium simum simum*) live in the grassy plains of South Africa (Emslie & Adcock, 1997). Many animals live in national reservations, but also on private game farms with native flora and fauna. Their main business is tourism but also hunting and dealing with wild animals. The management of

these farms have to calculate the ecological carrying capacity of white rhinoceros in their area to optimize the size of the rhino population. If the carrying capacity is reached, rhinos can be sold or exceptionally shot.

Nutrient analysis of the native grass connected with knowledge of digestibility would help to calculate the carrying capacity. Also, a connection between nutritional values, digestive abilities and food selection allows a better understanding of dynamic niche properties.

## Food and feeding site selection in White rhino at Ithala GR during Winter.

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In a 1 year field study the feeding ecology and the social system of the white rhinoceros (*Ceratotherium simum simum*) in Ithala Game Reserve, Zululand, were investigated.

The white rhino project was split into two different modules: the summer module, which was made by Claudia Handtrack from October 1995 until March 1996, and the winter module, which was made by myself from May 1996 until October 1996.

Ithala Game Reserve, one of the most important of the 78 protected areas administrated by Natal Parks Board, has been identified as key conservation area on the African continent by the African Rhino Specialist Group (IUCN) for white rhinos. As a key question this study was made to enable Natal Parks Board to calculate the ecological carrying capacity for white rhinos in Ithala.

The population growth of white rhinos in Ithala is not as fast as expected from data from other populations.

There were about 50 individuals less than expected in 1994. As the rate of population growth also is important for population genetic and demographical reasons, it is also adamant to know, and if possible remove, obstacles for optimal population growth in early stages of the program.

Therefore data about vegetation were collected every month, as e.g. proportions from different size classes of grass and forbs and greenness. The survey was carried out to describe changes in food availability and - quality:

In winter the feeding areas of white rhino are mainly concentrated on the Lowfield of Ithala and on areas in the valleys. White rhino do have special 'winter areas', where the temperature is more suitable. Some of these areas still do have sufficient grass in winter but with an decreasing quality, as e.g. greenness.

The question to answer is, whether Ithala Game Reserve is a suitable habitat for white rhinos' reproduction and conservation for future.

## Determination of genetic variation and relationship in the African Rhinoceros (*Ceratotherium simum*; *Diceros bicornis*)

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Many species are endangered due to habitat loss and poaching. The two species of the African Rhinoceros (*Ceratotherium simum*; *Diceros bicornis*) belong to this category. Considering the rapid decline of the rhino population it is not enough to save them only from habitat loss and poaching, but a specific breeding program has to be applied as well. Small populations can rapidly lose genetic variability and their capacity of genetic

adaptation is reduced. They become more vulnerable to changes in their environment, which can imperil their survival (Baur et al 1995; Foose 1991).

As the relationship of wild living animals is usually not known, an attempt to find a molecular genetic approach was made to determine dependency and identity control in the African Rhinoceros.

Due to lacking DNA sequence information in the rhinoceros a suitable PCR (Polymerase Chain Reaction) method