

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 considerably 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:

Götenboth (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.

Vitamine A deficiency can cause skin diseases, eye alterations and digestive dysfunctions.

Many zoo animals have low blood values of vitamine E, even rhinoceroses. Götenboth reported that average serum values of vitamine 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. Vitamine E deficiency can cause myopathia, general immune deficiency and is associated with the hemolytic anemia in black rhinoceros (Götenboth, 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 Itala 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.

Itala 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 Itala.

The population growth of white rhinos in Itala 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 Itala 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 Itala 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

adaption 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

had to be found to generate genetic markers from the uncharacterized genome. Therefore the sequence independent DNA fingerprinting method termed "amplified fragment length polymorphism (AFLP)" was established at the Institute for Animal Breeding.

The AFLP technique applied for animals is new as it was originally invented for plant genetics (Vos et al 1995) but it provides a powerful DNA fingerprinting technique for DNAs of any origin and complexity. Thus it could provide in the future a useful method to collect genetic data not only from the rhinoceros but also from other endangered wildlife species.

Polymorphisms are usually detected as the presence or absence of an amplified restriction fragment (Hill et al 1996). Every individual shows its specific band patterns. 24 AFLP Primer combinations were tested on DNA of unrelated white rhinoceros to select suitable maximum polymorphic primers. The resulting band patterns are repeatable and contain approximately 100- 200 visualized PCR products in the size range of 40- 500 bp (basepairs). In a computer-assisted analysis the similarity of the bands was determined. The analysed AFLP primer combinations showed between 0 and 25 polymorphisms. To achieve significant results 70 to 80 polymorphic loci are needed.

The successive use and value of these primer combinations as a dependency test has yet still to be proven. All experiments have to be repeated and polymorphic loci have to be verified. Related individuals have to be tested to select suitable primers and genomic loci for proof of dependency.

The experiments demonstrated that AFLP could provide a useful practical application for the conservation of the rhinoceros and for paternity testing.

Intraspecific differences in the behaviour of Okapis (*Okapia johnstoni*)

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Important intraspecific differences in behaviour are a phenomenon that has been reported for many species. Ontogenetic and genetic factors as well as the sex (different ecological constraints and strategies), the age and the actual environment of an animal all have a strong influence on behaviour.

This study aimed at quantifying intraspecific differences in behaviour in the zoo-population of the Okapi, a species which is known for a rather high variability in behaviour. Influences of enclosure, sex, age and reproductive status of the animals were examined. Therefore 14 animals (6 adult males; 6 fully adult and 2 younger females) were observed in 4 zoos in 5 different enclosures. Observations were done during late summer (on the outside enclosures) and during winter (in the stables). A time budget was constructed by measuring the duration of longlasting behaviours (like feeding, resting, etc.) and frequencies of some shorter behavioural elements of the functional systems exploration, enemy avoidance and

It could help to optimize breeding management and to prevent inbreeding. It would also enable forensic information and could be used in specific questions in customs declaration (CITES/ WAA).

The work will concentrate on blood and tissue samples of white rhinoceros (*Ceratotherium simum*) and black rhinoceros (*Diceros bicornis*) from different zoos connected to the EEP and of game ranches in Namibia and South Africa. Most animals of European collections, which have had breeding success and their offspring, will be screened.

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Literature:

- Baur, B. & Studer, P.(1995): Inbreeding in captive Indian rhinoceros (*Rhinoceros unicornis*). *Int. Zoo Yh.* 34: 205-211
- Foose, T.J.: Global management of rhinos. *Proceedings of an International Conference on "Rhinoceros Biology and Conservation"*, 9.-11. May 1991, San Diego
- Hill, M., Witsenboer, H., Zabeau, M., Vos, P., Kesseli, K. & Michelmore, R. (1996): PCR-based fingerprinting using AFLPs as a tool for studying genetic relationships in *Lactuca* spp. *Theor Appl Genet* 93:1202-1210
- International Rhino Foundation (1995): *Rhinoceros Husbandry Resource Manual*
- Vos, P., Hogers, R., Bleeker, M., Rejans, M., van de Lee, T., Hornes, M., Frijters, A., Pot, J., Peleman, J., Kuiper, M. & Zabeau, M. (1995): AFLP: a new technique for DNA fingerprinting. *Nucl Acids Res* 23: 4407-4414

social behaviour. Additionally, animals were observed for 3 h in a test situation after the introduction of a new enrichment object. Here, the numbers of direct contacts with the object were recorded.

The activity budgets recorded on the outside enclosures seemed to be in better correspondance with in situ data than the activity budgets recorded in the stables; outside the animals had higher activity levels during morning and afternoon sessions in comparison with the noon sessions (a comparable distribution is reported from in situ). The activity budget in the stable did not show these characteristics.

Oral disturbances, which were performed by some animals, seemed to be less in enclosures with permanent opportunity to forage on naturally growing vegetation.

In this study, sex specific differences contributed an important part to intraspecific variability in okapis. Males showed more locomotion and displayed more social and exploratory behaviour than females, while the

latter were observed to perform more resting and also more enemy avoidance behaviour. An interesting point was that females also seemed to be more prone to oral disturbances. These data fit rather well with data known from in situ. Males are reported to have larger and less exclusive home ranges and to show much more locomotional activity than females. As in every solitary living polygynous species, one might expect the males to be socially more active. Females are reported to hold (more or less exclusive) home-ranges with the best foraging conditions. In addition to the very high nutritional de-

mands during late pregnancy and lactation, Okapi females are usually taller and heavier than males. This combination may result in a higher difference in feeding motivation than in most other species.

In the new-object test, two groups of animals (more respectively less interest in the new object) could be distinguished, but there was only considerable positive correlation with exploratory behaviour and negative correlation with resting behaviour. Considering males and females, no differences could be found.

Development of captive horn dolphin calves in the first months

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The theme of my diploma writing is the comparison of the development of two dolphin calves in the dolphinarium II of the zoo in Nuremberg.

Both dolphin calves had the same father "Moby", but they had different mothers "Eva" and "Emy". The calf of Emy was born on December 12, 1997 and Eva's on January 1, 1998.

The mother animals lived with their calves in two separate basins which were connected by sluices and channels.

During the period of my observation all sluices remained closed.

During the taking up of the data neither the technical equipment nor the maintenance conditions have been changed.

The aim of the study was to find out if the different experience or inexperience, respectively of the mother animals influences the development of the calves and how strong the same is or how their influence effected the calves.

Moreover, the total development of the two dolphin calves has been observed and analysed.

For the taking of the data and informations video cameras had been installed above the two swimming basins, which were in performance 24 hours a day.

These video cameras had been connected directly to VHS - videorecorders, which accumulated day and night the data on VHS - cassettes.

For the analysis of these diploma data special programs of calculation and information named "CetaDat" had been created and employed, which protocolled all behaviour manners in the utmost accuracy.

To this effect all video pictures had been scrutinized by hand and put in to a PC with "CetaDat".

In this way the percentage rates of all the behaviour kinds could be evaluated.

As indication for a certain independence of the calf, among others, the percentage rates of the solitary breathing related to the total synchronous breathing, has been determined.

Likewise, the percentage rate of the particular kinds of swimming compared with the synchronous swimming during which the calf swims next to the mother animal passes for indication of independence.

The studies revealed different developments correlated with a different maturity degrees of the dolphin calves.