Concept Husbandry Guidelines for the White Rhinoceros *(Ceratotherium simum)*

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In assignment of
Lars Versteege, EEP co-ordinator white rhinoceros

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Summary

The white rhinoceros (*Ceratotherium simum*) is stated as 'near threatened' since 2002 by the IUCN. The EAZA rhino collection is not self-sustaining. In addition to a breeding program, EAZA husbandry guidelines are developed in order to share knowledge on best husbandry practise among the European institutions keeping white rhinoceros in captivity. By increasing the knowledge, the conditions for the well-being and reproduction of all animals in the European Endangered species Program (EEP) can be optimised which will benefit the possible establishment of a sustainable ex situ population.
The research goal is to produce concept husbandry guidelines providing information on biology, field data and white rhino management in captivity. The rhino TAG need to finalize this document into final husbandry guidelines.
In the first section, the in situ situation of the white rhinoceros is described in the chapters biology and field data. These data were collected through a literature study.
The second section describes the recommendations for management in captivity divided into chapters according to the EAZA guidelines for husbandry manuals. The data for these chapters were collected through literature study and by interviewing twelve international white rhinoceros experts through a questionnaire. This questionnaire consisted out of 141 questions, asking for the best practice on many subjects. The experts were selected by the EEP co-ordinator and most of them are members of the EEP committee. Ten experts responded to this questionnaire. The data collected are incorporated in concept husbandry guidelines in such a way that it is easy for the EEP committee to review and edit the document into the final husbandry guidelines.
Especially the EAZA draft EEP Husbandry Guidelines for African Rhinoceroses and the selected experts together with parts of the AZA Rhinoceros Husbandry Resource Manual are used as main sources during the construction of this document. More and more information becomes available so the husbandry guidelines need to be updated regularly.
The white rhino experts agreed with one another on most husbandry subject but opinions on some topics, like social structure and especially breeding, differed a lot. This raises a problem for captive reproduction. The captive diet of a white rhino is in great contrast with the natural feeding ecology. A white rhino in the wild is consuming large amounts of short grasses. The Zoos are feeding in addition to grass and hay also fruit, vegetables and even processed food like bread and flaked maize. Also breeding and social structure differs from the wild situation. In the wild female groups up to six animals are commonly seen and males live basically solitary and associate only with females during oestrus. In captivity it is advised only recently to hold 2.3 white rhinos. This has implications on enclosure size and design when wanting to mimic the wild situation.

Preface

Because we both focus on a future career as a zoo curator, the subject of our final thesis wasn't hard to establish. We individually decided that making husbandry guidelines would help us understand the modern zoo community better with all its dimensions and factors. This research made it possible to get in contact with international zoo curators and experts and we learned a lot about keeping white rhinos. We are convinced that we now know how to make concept husbandry guidelines for every species in all zoos.

This study is carried out as a final thesis at the University for Applied Science Van Hall Larenstein, Leeuwarden, the Netherlands, from April 2010 till October 2010. During this time we were supervised by Tine Griede and Ans Meiners of Van Hall Larenstein. Our initiator was Lars Versteege from Safari park Beekse Bergen, who is the EEP co-ordinator of the white rhinoceros. We want to thank them for all their help and support and Lars for his expertise on the white rhinoceros husbandry.

Many experts have shared their knowledge with us about the husbandry of these animals. They were of great importance since without their expertise it would have been impossible to compile these husbandry guidelines. Our thanks go to Frank Brandstätter, Sarah Forsyth, Volker Grün, Mark Holden, Bob Lawrence, Torsten Möller, Kim van de Put, Endre Sós and Nick Whiting for helping us, by completing the questionnaires.

Wiebe Boomsma and Martijn van der Sijde
Leeuwarden, October 2010

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Introduction

Problem description

One of the main goals of modern zoos worldwide is conservation (WAZA, 2010). According to the IUCN red list 37% of all evaluated species are threatened (17.291 threatened species) (IUCN, 2010a). To keep the white rhinoceros (*Ceratotherium simum*) from extinction and to maintain a healthy, sustainable captive population, the European Association of Zoos and Aquaria (EAZA) started an European Endangered Species Programme (EEP) (Versteege, 2010a; EAZA, 2009a). The numbers of white rhinos are increasing and therefore the white rhino is stated as near threatened since 2002 by the IUCN (IUCN, 2010b). Nowadays 527 white rhinos in captivity are registered on ISIS worldwide, with 247 of them in European zoos. (ISIS, 2010) The first registration of a white rhino kept in an European zoo was in 1950 (Versteege, 2010a).

Each animal species group in EAZA institutes got its own so-called Taxon Advisory Group (TAG). The members in a TAG are zoo and aquarium professionals who work in EAZA member institutions and have specialist knowledge and a keen interest in the group of species covered by the specific TAG. (EAZA, 2009b) When an EEP is approved for a species by the EEP committee a co-ordinator is assigned. To control and support his actions a commission is formed. The co-ordinator is usually one of the members of the specific TAG. (Griede, 2010) One of the tasks of an EEP co-ordinator is to produce husbandry guidelines (EAZA, 2009c). The EEP co-ordinator for the white rhino is Lars Versteege (curator of Safari Park Beekse Bergen).

EAZA is developing husbandry guidelines for every species kept in member zoos. In these guidelines information is given on the best practice. The best practice serves multiple goals, i.e. higher welfare resulting in better reproduction success and exchange of animals between EAZA institutions is more practical. Both goals enhance conservation efforts. This way the breeding program can meet its goals to get a sustainable ex situ population. Proper animal husbandry is needed for good population management and helps conservation of white rhinoceros. (EAZA, 2009b)

Goal

The research goal is to produce concept husbandry guidelines, with information on biology, field data and according to literature and the opinions of different experts on white rhino management in captivity.

These concept husbandry guidelines can be used by the rhino TAG to produce the final EAZA husbandry guidelines for the white rhino which form a management goal of EAZA. The husbandry guidelines can be used by EAZA institutions as a manual for captive white rhino management.

Research questions

1. **What is known about the biology and field data of the white rhinoceros (*Ceratotherium simum*)?**

2. **What is the best practice for managing white rhinoceros in captivity?**

2a. What is the best practice for responsible management of white rhinoceros for the subjects from the husbandry guidelines format (Appendix 1)?
2b. What are relevant health and welfare issues and precautions for white rhinoceros?
2c. What are the species specific problems with keeping white rhinoceros?
2d. What other information is helpful to complete white rhinoceros husbandry guidelines?

Methods

Research type and design

This research is a describing non-experimental survey research (Baarda and De Goede, 2001). The research questions are answered by a literature study and information gathered by a questionnaire, completed by the selected experts. Twelve experts where contacted.

Research population

All experts who were contacted (listed in table 1) are zoo personnel with the best expertise on keeping white rhinos in captivity according to Lars Versteege.

Table 1. Experts

Name	Institution	Country	Expertise
Frank Ahrens	Zoo Gelsenkirchen	Germany	
Frank Brandstätter	Zoo Dortmund	Germany	
Sarah Forsyth	Colchester Zoo	United Kingdom	
Volker Grün	Zoo Duisburg	Germany	
Mark Holden	Whipsnade Wild Animal Park	United Kingdom	
Bob Lawrence	West Midlands Safari Park	United Kingdom	
Torsten Möller	Kolmården Zoo	Sweden	Veterinary
Richard Osterballe	Givskud Zoo	Denmark	
Kim van de Put	Burgers' Zoo, Arnhem	Netherlands	
Endre Sós	Budapest Zoo	Hungary	Veterinary
Lars Versteege	Safaripark Beekse Bergen	Netherlands	EEP co-ordinator
Nick Whiting	Woburn Safari Park	United Kingdom	

Data collection and preparation methods

All information for section 1 of the husbandry guidelines (the biology and field data) has been collected through literature study. The information was analyzed by using a labeling method, the articles are labeled by year of publication, subject and author.

For the white rhino husbandry in zoos, section 2, twelve experts on white rhino husbandry were asked to fill in a questionnaire. The AZA Rhinoceros Husbandry Resource Manual (Fouraker and Wagener, 1996) and the EAZA draft EEP African Rhinoceroses Husbandry Guidelines for Rhinoceroses (Goltenboth *et al.*, 2001) are used during the construction of this document. The process of the design is shown in a survey research model in figure 1.

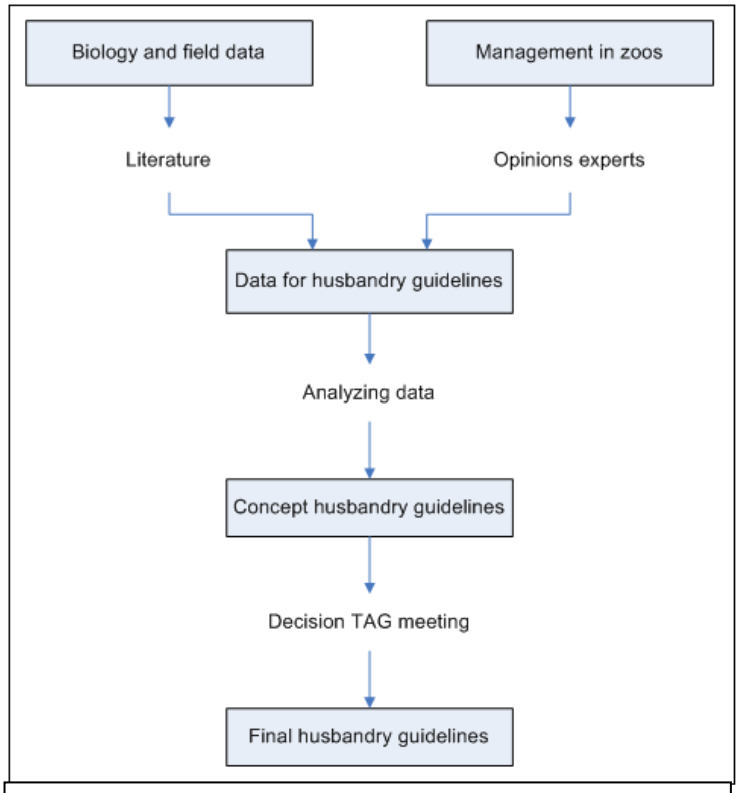

Figure 1. Model of the process to design husbandry guidelines

The literature consists of scientific articles and books. Recent research is preferred over older research, although older articles were used when no recent articles were available. The information that is appropriate for the concept husbandry guidelines according to the husbandry guidelines format (appendix I) was selected. The EEP co-ordinator notified the experts in advance about participating for the questionnaire for good communication and co-operation. The opinions from the experts are collected through a questionnaire. The questionnaire was made in the program 'survey monkey'.

All answers from the experts were incorporated to show all possible options that were used for the management of the white rhinos. The TAG has to choose which one of the options is the best practice. All other options can be removed easily from the concept text. This will result in the final husbandry guidelines for the white rhinos.

Results

Section 1 - Biology and field data

1.1 Biology

This chapter covers basic biological information relevant to in situ and ex situ white rhinos. Successively, taxonomy, morphology, physiology and longevity are discussed.

1.1.1 Taxonomy

The taxonomic position of the white rhinoceros (*Ceratotherium simum*) is described by Burchell (1817), including all living sub species.

Kingdom: *Animalia* (Animals)
Phylum: *Chordata* (Chordates)
Sub phylum: *Vertebrata* (Vertebrates)
Class: *Mammalia* (Mammals)
Order: *Perissodactyla* (Odd-toed ungulates)
Family: *Rhinocerotidae* (Rhinoceros)
Genus: *Ceratotherium* (White rhinoceros)
Species: *Ceratotherium simum* (White rhinoceros)
Sub species: *Ceratotherium simum cottoni* (Northern white rhinoceros)
Ceratotherium simum simum (Southern white rhinoceros)

There are many common names for the white rhinoceros, including:

- White rhinoceros
- White rhino
- African white rhinoceros
- Square-lipped rhinoceros
- Square-mouth rhinoceros
- Grass rhinoceros (Kingdon, 1997)
- Burchell's rhinoceros (Rookmaaker, 2003)

The scientific name for the white rhino is *Ceratotherium simum*, in which the Greek *cerato* means 'horn' and *thorium* means 'wild beast'. The Greek *simus* means 'flat nosed' (RRC, 2010).

Ten different theories are listed to explain the name 'white rhinoceros' for an animal that is grey, not white. The popular explanation is that 'white' is derived from the African words 'wyd', 'wyt', 'weit' or 'weid' (all meaning wide) referring to the wide mouth, but this is examined and found to be unsubstantiated and historically incorrect. (Rookmaaker, 2003)

1.1.2 Morphology

Rhinos are grey and almost hairless (hair only on ears, tail tips and eyelashes). The head hangs down and only looks up when alarmed (see figure 2). White rhinos have a wide upper lip and a noticeable hump on the back of their neck (see figure 2 and 3). The front and back feet each have three toes, at the front a soft and elastic sole. (RRC, 2010; Fouraker and Wagener, 1996; Tomasova, 2006) The measurements of these mega herbivores are shown in table 2 (Foster, 1960; Pedersen, 2009; Tomasova, 2006).

Figure 2. An alarmed rhino looks up

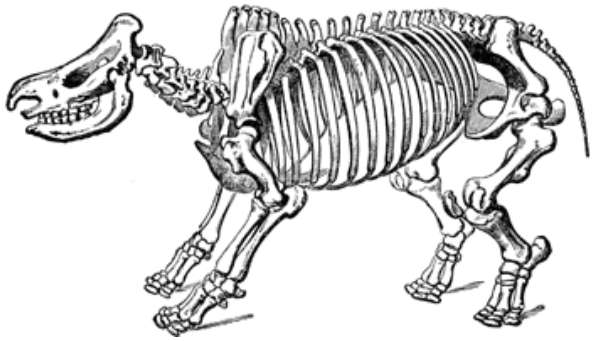

Figure 3. Illustration of the skeleton of a rhinoceros

Table 2. Measurements of the white rhinoceros

Measurements	Adult male	Adult female	New-borns
Weight	1800 - 2500 kg	1600 - 2000 kg	40 - 60 kg
Head body length	3.8 - 5 m		-
Tail length	50 - 70 cm		-
Shoulder height	1.5 - 1.8 m		-
Anterior horn	94 - 102 cm		-
Posterior horn	Up to 55 cm		-

In table 3 the dental formula of white rhinos is described. "The deciduous premolars 2, 3 and 4 are replaced by permanent premolars, while premolar 1 is not replaced" (Hillman-Smith *et al.*, 1986). Hillman-Smith *et al.* (1986) found no signs of incisors or canines in their study.

Table 3. The typical dental formula for white rhinos

	Incisors	Canines	Premolars	Molars
Deciduous	0/0	0/0	4/4	0/0
Permanent	0/0	0/0	3/3	3/3

1.1.3 Physiology

Information on heart rate, respiration rate and rectal temperature is listed in table 4 (Citino and Bush, 2007).

Table 4. Physiologic parameter of the white rhino

Physiologic parameter	Mean	Min.	Max.
Heart rate (beats/min)	39	32	42
Respiratory rate (breaths/min)	19	16	23
Rectal temperature (°C)	36.8	36.6	37.2

White rhinos have a very powerful olfactory sense (Pedersen, 2009; Tomasova, 2006: Grün, 2006). Hearing is sensitive when not disrupted by other environmental noises (Pedersen, 2009; Tomasova, 2006). The eyesight is poor, they can only see motionless forms between 15 to 25 meters away (Owen-Smith, 1973; Tomasova, 2006).

1.1.4 Longevity

In the wild a white rhino can reach an age of 40 to 50 years (RRC, 2010). In captivity a white rhino can reach an age of 50 years (Tomasova, 2006).

1.2 Field data

This chapter relates specifically to white rhinoceroses in the wild. It includes information on geography and ecology, diet, reproduction and behaviour.

1.2.1 Geography and Ecology

Distribution

The southern white rhino is now the most numerous of the rhino taxonomical group. South Africa is the stronghold for this subspecies with sizeable populations in the Kruger national park and Hluhluwe-Imfolozi. Smaller populations also occur in numerous state protected areas and private reserves (some of which are also well protected). There are smaller reintroduced populations within the historical range of the species in Namibia, Botswana, Zimbabwe and Swaziland, while a small population survives in Mozambique. Populations also have been introduced outside of the former range of the species i.e. to Kenya, Uganda (meaning that the species has been reintroduced to this country) and to Zambia, as can be seen in figure 4 (Emslie and Brooks 1999). The majority (98.8%) of white rhino occurs in just four countries, namely South Africa, Namibia, Zimbabwe and Kenya (Milliken *et al.*, 2009).

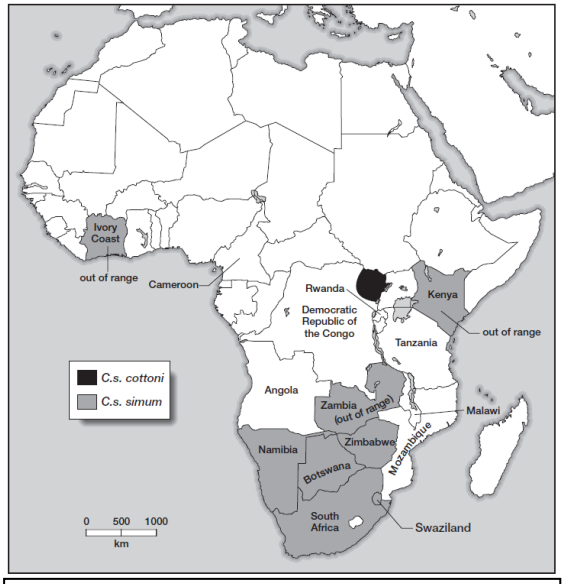

Figure 4. Distribution of the two sub species of white rhinoceros, *C. s. cottoni* and *C. s. Simum

* Note: At the request of certain members, the African Rhino Specialist Group (AfRSG) has a policy of not releasing detailed information on the whereabouts of all rhino populations for security reasons. For this reason, only whole countries are shaded on the map.

Habitat

White rhinos prefer short-grassed savannah with access to thick bush cover for shade and water holes for drinking as well as wallowing. The optimal habitat is a combination of grassland and open woodland. (Tomasova, 2006)

Population

December 2007, there were an estimated 17,474 white rhinos in the wild (see Table 5). In December 2005 there were an estimated 760 in captivity worldwide (750 *C. s. simum* and 9 *C. s. cottoni*). (Milliken *et al.*, 2009)

Table 5. Estimated white rhino numbers in wild- / national parks in December 2007 by country

White rhinoceros			
	C.s. cottoni	C.s. simum	Trend since 2005
Botswana		106	up
DR Congo	4		stable?
Kenya		303	up
Mozambique		9	?
Namibia		370	up

White rhinoceros			
	C.s. cottoni	C.s. simum	Trend since 2005
South Africa		16.273	up
Swaziland		89	up
Uganda		6	new
Zambia		1	down
Zimbabwe		313	stable
Total	4	17.470	up

Conservation status

The southern white rhinoceros is listed as 'Near Threatened' by the IUCN. The reason for rating this species as 'Near Threatened' and not 'Least Concern' is due to the continued poaching threat and high illegal demand for horn (as determined from intelligence gathering by wildlife investigators). (IUCN, 2010b)

The northern white rhino is listed as 'Critically Endangered' as the current population of the sub species is no more than four individuals (all surviving in the Garamba National Park in the northeast of the Democratic Republic of Congo), down from an estimated 2.230 individuals in 1960. Worryingly, recent surveys undertaken in Garamba have failed to confirm the presence of the subspecies in this area. (IUCN, 2010b)

By 1977, all African rhino species were listed on CITES Appendix I, and all international commercial trade in rhinos and their products was prohibited. However, following a continued increase in numbers, the South African population of Southern white rhino was down-listed in 1994 to CITES Appendix II, but only for trade in live animals to "approved and acceptable destinations" and for the (continued) export of hunting trophies. In 2004, Swaziland's Southern white rhino was also down-listed to CITES Appendix II, but only for life export and for limited export of hunting trophies according to specified annual quota. (IUCN, 2010b)

1.2.2 Diet and feeding behaviour

The white rhinoceros is a grazing mega herbivore (Owen-Smith, 1988), consuming large amounts of short grasses and no intake of browse at all (Steuer *et al*., 2010). Their rapid bulk feeding allows them to tolerate food of a lower quality than that required by smaller herbivores (Owen-Smith, 1988). "The natural diet of any rhinoceros species is characterized by a high-fibre and low-to-moderate protein content" (Clauss and Hatt, 2006). Because of the high fibrous diet they evolved "high crowned cement covered teeth to cope with their feeding demands, as well as a lengthened skull and wide lips" (Owen-Smith, 1973). White rhinos can live up to 4 to 5 days without water (RRC, 2010).

Although good quality food is more abundant in the wet season (Pedersen, 2009), white rhinos generally do not over utilize food in their natural habitat (Shrader and Perrin, 2006). The movements throughout the landscapes are influenced by water sources and rainfall (Shrader and Perrin, 2006). In the dry season white rhinos "do not compensate for seasonal declines in food quality by adjusting their food intake rate or diet breadth" (Shrader, 2003; Shrader *et al*., 2006). Shrader *et al*. suggest that white rhinos rely on fat reserves to help them through the period of less quality food. Pederson (2009) states that these animals "are maximising the opportunities to graze on nutritious grasses when they are available". He concluded that white rhinos are succeeding in exploiting the less than ideal grasslands that they live in. Due to the feeding ecology of the white rhino, grasslands are changed by them into a more suitable habitat for other grazers. (Waldram *et al*., 2008).

Pedersen (2009) found 43 grass species consumed by white rhinos. The nine most consumed species represent 50% of the annual diet. The 20 most consumed species that make up 79% of the annual diet are *Aristida adscensionis, Bothriochloa insculpta, Brachiaria serrata, Brachiaria xantholeuca, Cenchrus ciliaris, Chloris gayana, Digitaria eriantha, Enneapogon cenchroides, Eragrostis cilianensis, Eragrostis lehmanniana, Eragrostis rigidior, Eragrostis superba, Eragrostis tricophora, Heteropogon contortus, Ischaemum afrum, Panicum coloratum, Panicum maximum, Pogonarthria squarrosa, Schmidtia pappophoroides, Stipagrostis uniplumis.*

1.2.3 Reproduction

Information on oestrus, sexual maturity, copulation, gestation, breeding, birth, delivery and infants is listed in table 6.

Table 6. Reproduction facts for the white rhino

Subject	Details	Reference
Sexual maturity	♂ and ♀ 3 – 6 years	Goltenboth *et al*., 2001
Age at birth of last calf	♀ mean: 17.1 years range: 7.2 – 31.1 years ♂ mean: 19.7 years range: 7.2 – 29.2 years	Fouraker and Wagener, 1996
Delivery	Labour ± 40 minutes Parturition 10 - 20 minutes Evening or night	Goltenboth *et al*., 2001
Breeding season	Peaks in July, Sept and Dec/Jan	Fouraker and Wagener, 1996
Birth peaks	April/May, June/July, Nov-Jan	Fouraker and Wagener, 1996
Birth intervals	Mean: 30 months	Fouraker and Wagener, 1996
	Range: 24 – 48 months	Grün, 2006
Oestrus cycle length	27 – 44 days ♂ interested 24 – 48 hours ♀ receptive 12 – 18 hours	Fouraker and Wagener, 1996
	28 - 32 (up to 70) days ♂ interested 24 – 48 hours ♀ receptive 12 hours	Goltenboth *et al*., 2001
	Short: ± 35 days Long: ± 66 days	Patton *et al*., 1999
Copulation	20 - 60 minutes	Tomasova, 2006
	30+ minutes Several copulations at peak of oestrus Copulations mostly takes place at dusk or dawn	Goltenboth *et al*., 2001
Gestation period	485 – 518 days	Fouraker and Wagener, 1996
	± 490 days	Grün, 2006
	515 - 540 days	Goltenboth *et al*., 2001

Subject	Details	Reference
Age at birth of first calf	♀: 10.7 (5.6–23.5) years ♂: 15.5 (7.2 – 25.2) years	Fouraker and Wagener, 1996
	♀ 6-7 years	Grün, 2006
	♀ 6.5 - 7 years ♂ 12 years	Goltenboth *et al*., 2001
Calf behaviour	Standing up after ± 15 minutes First nursing 1 - 24 hours after birth	Goltenboth *et al*., 2001
	Begins grazing at 2 months of age, weaning after 1 year and it leafs its mother at 3 years of age.	Tomasova, 2006

1.2.4 Behaviour

White rhinoceroses feed and rest alternately during 24 hours. In hot, dry weather they rest during the hottest part of the day. Much of their resting time is spent wallowing to keep cool and to get rid of skin parasites. If no wallowing place is available, they will roll in dust. (Tomasova, 2006) White rhinos may reach speeds of 50 km/h (RRC, 2010).

White rhinos are sedentary, semi-social and territorial. Adult females and sub-adults are rarely solitary. They associate typically in pairs, usually a female with her latest calf. A juvenile stays with the mother for around three years. When the mother calves again, the juvenile seeks another companion, preferably of similar age and the same sex. Stable herds of up to six animals can be commonly observed, while larger groups are the result of temporary aggregations, purpose-made because of availability of favourable food, watering, or resting conditions. Females' home ranges vary between 6-20 km², and usually overlap several males' territories.

The adult bulls are basically solitary and associate only with females in oestrus. Bulls' territories are relatively small, averaging between 1-3 km². The size depends on many factors, including the quality and availability of food and water. Each territory is held by a mature male, often with between 1 - 3 resident satellite bulls. The territory owner ignores these satellite bulls, as long as they behave submissively. Territorial bulls treat foreign intruders far more aggressively than the resident satellite bulls do. (Tomasova, 2006)

At the end of the dry season, when water is scarce some males have to cross other territories on their way to water. This leads to an increase in conflict and more fighting ensues. Typical fighting wounds seen on male white rhinos other than obvious lacerations on the head include broken jaw bones, wounds between the hind legs, punctured abdomens, broken front legs and dislocated hind legs. These wounds are usually fatal. (Pienaar, 1994)

As with the other rhino species, white rhino home ranges are scent-posted with dung heaps placed by both sexes. The collective dung heaps, or 'middens', are usually located at territory boundaries and serve as communication and marking points. All animals add their deposits there, but only territorial males scatter the dung with ritualized kicks and spray urine. (Tomasova, 2006) When a subordinate male gets confronted with a territorial male, it gives a threat display. He lifts its head, roars and makes short rushes at the territorial male. (Pienaar, 1994) White rhinos also communicate vocally, using a wide range of sounds from calf squeaking to snarling or wailing of adults (Tomasova, 2006).

Section 2 - Management in zoos

Reading instruction
The information in this section is compiled from literature and the opinions of experts.
All expert opinions are labelled with a-j:

a = Frank Brandstätter	f = Torsten Möller
b = Sarah Forsyth	g = Kim van de Put
c = Volker Grün	h = Endre Sós
d = Bob Lawrence	i = Lars Versteege
e = Mark Holden	j = Nick Whiting

All different expert opinions are shown in the text of this concept husbandry guidelines with their label. This way the most suited options can easily be chosen and the other ones be erased. When this editing is done the result will be the final version of the husbandry guidelines. To make it even easier to erase, the opinions are written in italic font style if a choice has to be made between different options.

All management actions should be in line with the EAZA minimum standards for the accommodation and care of animals in zoos and aquaria (as found in appendix II).

2.1 Enclosure

When designing an enclosure, zoo planners should address a lot of general issues to make a safe and easy-to-maintain exhibit (Veasey, 2005). Not only the animals' biological and physiological needs should be taken into account (Curtis, 1982), but the people who daily manage and maintain the exhibit, need to be considered as well (Simmons, 2005). The more natural an exhibit looks, the better it is to tell an ecological message. Visitors should not see any bars or mash but should have the idea that they are in the habitat of the animal. (Hosey *et al*., 2009) As stated before, the white rhino is kept in European zoos since the 1950s. They do *not* [c] */ need* [abdefghij] a separate in- and outdoor enclosure. An indoor enclosure is only needed when there is a cold and wet season [c].

2.1.1 Dimensions

For 1.3 rhinos, 2 hectares are sufficient. The compatibility of the group [d] and the design of the enclosure are more important than size, as white rhinos are gregarious, but they also like their own space [e]. The inside enclosure should be *at least 30 m²* [abdefghij] */ more than 30 m²* [c] and 3.5 m high per individual (Goltenboth *et al*., 2001). When a calf is present, an additional 15 m^2 should be available [abdefghij]. However, the size depends on a range of factors, like how much time is spent indoors, the proximity to public etc., and more space is better when possible [e].

The minimum outside space requirements for 2.3 adult rhinos is *1 hectare* [bhi] / *2 hectares* [cfg] / *3 hectares* [dj]. But if the space is well structured it could be acceptable to have less space available [c] (e.g. 0.7 ha) [a].

For every extra animal *0.25* [bcdhi] / *0.50* [fgj] / *1* [e] hectare should be added to the minimum space. The outside space must contain separation possibilities as well [h]. It is recommendable to create several enclosures which are connected. This way separate territories could be made for the males and the female, and exchange between territories [i] is possible.

A surplus facility is needed for animals that can't be placed in the current group [abcdefghij]. These animals should have their own indoor pen [abcdefghij] and outside paddock [abcdefghij]. The surplus - and/or quarantine area should be *700* [dfh] / *900* [c] / *1100* [bgij] m^2 depending on group size and length of quarantine [d]. Since a surplus area will be used more often to separate the bull, it should be larger [i].

2.1.2 Boundary

The paragraph boundaries will describe the walls of the pens of the inside enclosure and all primary and secondary boundaries outside. Some examples of boundaries can be seen in figure 5. The advantages and disadvantages of different boundary types can be found in table 7 (see next page)(Hosey *et al.*, 2009).

a **b** **c** **d** **e**

Figure 5. Examples of primary fencing
a = wooden posts close together to form a wall, b = horizontal cables with protection, c = diagonal bars, d = wooden posts spaced apart to allow contact, e = horizontal pipes/bars

The bars of an enclosure should be placed *vertical* [acdefgh] / *diagonally* [bij]. At least one side of the pens and corridors must be made out of vertical bars or poles to allow the keeper an emergency exit [d] (Goltenboth *et al.*, 2001) and this way climbing can be prevented [e]. When using horizontal cables abrasion takes place when the animal is bored [h] which results in damage of the horn (see figure 6).

Figure 6. Abrasion on the second horn

Table 7. The advantages and disadvantages of commonly used barriers in zoo enclosures

Type	Advantage			Disadvantage		
	Animal	Keeper	Visitor	Animal	Keeper	Visitor
Solid *	Depending on height, provides safety Prevents disease transmission	Separates animals Prevents visitors from feeding animals	-	Can lead to injury if animals collide with it Can prevent view of surroundings May affect communication between animals	Can prevent view of the animals	Obstruct view of animals
Partial **	Can provide greater usable space	Can aid introductions	Restricted viewing can make a glimpse of an animal more exciting	-	-	Can obstruct view, although some materials are less obvious Considered 'unnatural' Does not prevent human-animal interaction
Bars	Can provide greater usable space	Can facilitate keepers' escape from the enclosure, whether the bars are vertical or diagonal	-	-	-	Associated with negative connotations of animal welfare As above
Electric	Can learn to avoid it	Easily creates temporary barriers Cheap	Good visibility	Not visible so can get injured Can get entangled in it A deterrent, not 'fool-proof'	Some body parts do not conduct electricity, e.g. horns, hair	Needs to be well signed as a hazard and out of public reach
Moat	Rhino may use the water or objects in it	-	Provides 'naturalistic' view Invisible barrier between species	Water can provide a route for disease transmission A lot of space is required, which cannot be used by the animals in most situations	Dry moats can flood Wet moats can freeze Need method to access animal and/or enclosure safely	Increases the distance between the visitors and animals, which can reduce visibility

* Materials include: concrete wall, brick wall, wooden posts against each other etc.
** Materials include: metal posts, wooden posts, cable, etc.

The primary barrier should always have a minimum height of *1.5* [abcdefhi] / *2.0* [gj] m (Goltenboth et al., 2001) and be non-climbable [abcdefghij].

The barrier can be made out of a *dry moat* [abcdfghij], / *water moat* [cgi] / *posts with horizontal cable* [aef] / *posts without horizontal cables* [abefghi]. A barrier of rocks can be used as well [b] and is recommended for the protection of trees and other objects (Goltenboth *et al*., 2001). The primary boundary should only be treated with a non-toxic composition (Goltenboth *et al*., 2001). *The distance between the bars should be as small as possible to prevent the rhinos from getting their horns through* [bghj]. / *Keepers should be able to get through the bars, but the rhino shouldn't get stuck* [cg]. The ideal spacing is: *30-40* [def] / *25-30* [h] / *20* [ai] / *15* [j] cm between the bars, the distance between the bars depend on what kind of bars are used [f]. Standing posts should be 30 cm in diameter and set in concrete to 1.8 m under ground level [abcdeghij] (Goltenboth *et al*., 2001).

When designing an outdoor exhibit which incorporates a moat (see figure 7), the slope must be made out of a non-slippery surface to prevent injuries. On the animals' side the moat should slope gradually, not exceeding 30 degrees because this part may also be used by the animals (Goltenboth *et al*., 2001). The wall on the visitor side of the moat should be at least *1.0* [efi] / *1.5* [a] / *2.0* [bgj] m high (Goltenboth *et al*., 2001).

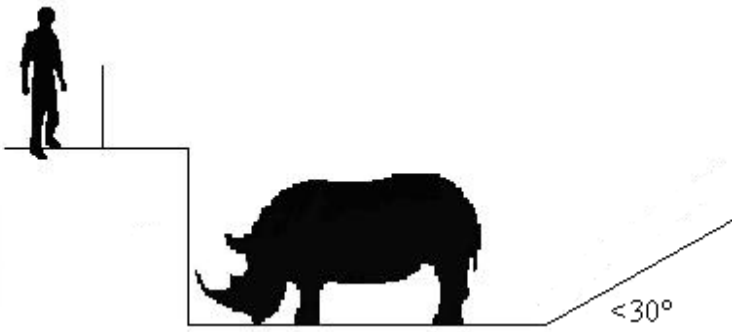

Figure 7. Example of a dry moat

Ditches with strictly vertical walls are considered dangerous and are not suitable for white rhinos, especially with social grouping (Goltenboth *et al*., 2001).
Recommendation is that existing vertical ditch walls should be modified to gradual sloping. As interim solution, escapes on either side of the ditch must exist (Goltenboth *et al*., 2001).

A secondary barrier can be made out of electric fencing [abcdefgij], white rhinos have been seen to retreat from the fence after receiving an electric shock (Holsey *et al*., 2009). The electric fencing should be placed at *0.3* [defgij] / *1.0* [abchj] / 1.5 [j] m of the ground. Electric tapes can be used since these are more visible and more resistant [h]. It is best to use more than one electric strand [j].

The walls of the inside enclosure should be made out of solid concrete or rock walls [abcdeghhij]. The walls of the inside enclosure should be unpainted since white rhinos will rub against the walls, a concrete stain is preferable. Waterproofing wall surfaces by covering them with sealant makes cleaning much easier. (Rosenthal & Xanten, 1996)

Each wall of the inside enclosure should be at least 5 m long and the separating walls should be at least 2 m high to give the white rhinos the space they need to move. For separation walls horizontal pipe or cables spaced 25 to 30 cm apart and vertical pipe or posts spaced 25 to 30 cm from each other [abcdeghhij] (Goltenboth *et al*., 2001) can be used. The spaces between the bars should be 20 cm to prevent a calf from escaping [b] (Goltenboth *et al*., 2001).

Separating walls are used to create pens. *One pen per animal plus one additional pen is recommended* [abcdhij]. /*In the stable all animals can be kept in one large area* [ef]. Compatible females can share a pen, but holding pens should be available to be used if necessary [def]. *Males and females can share one outside enclosure, but not one inside enclosure* [g]. The pens should be large enough to accommodate more than one rhino [j].

It is recommended that at least one opening can be moved per pen combination. Solid door panels can be used as a visual barrier and bars to allow visual contact (Goltenboth *et al*., 2001).

The inside enclosure should always have more than one [abcdefghij] entrance to prevent animals from getting trapped by others. An escape route should always be available.

Doors should be reinforced with strong hinges and locks (see figure 8). They should be constructed of either heavy metal, galvanized steel, pipe that is either hinged or sliding, or of wood reinforced with steel. The bottom part of a door should be reinforced with steel plates to minimize possible damage. (Goltenboth *et al*., 2001)

Figure 8. Strong steel door hinges

Connecting pathways and tunnels between indoor/outdoor facilities should be approximately 1.5 m wide for an adult animal to pass freely without feeling trapped, but to prevent it from turning back. Long pathways should have bar doors to be closed after the animal has passed through. Outdoor facilities must have at least 1 entrance/exit for heavy trucks or cranes. (Goltenboth *et al*., 2001)

2.1.3 Drive-through enclosure

White rhinos are often kept in drive-through enclosures, since a drive-through has a high educational value for the visitors and of enrichment value for the animals [i].

It *is* [bcdefghij] / *is not* [a] possible to keep white rhinos in a drive-through enclosure. The character of the individual rhinos [h], whether the animals are accustomed to vehicles, the size of the enclosure, the type of vehicles, etc. [f] are all factors influencing the suitability of an individual white rhino for a drive-through enclosure.

The gates in a drive-through enclosure can consist out of a *sluice* [cefhi] / *cattle grid* [cdij] / *electric floor mat* [bdeij] and should be manned by a gate marshal or keeper in Landrover [b]. A contingency manual gate should be constructed as well [d].

2.1.4 Substrate

White rhinos can suffer from nail cracks and laminitus (see chapter 2.7.1). This means that the substrate they are walking on is very important. The best types of substrates for the stables are *wood chips* [dgij] / *concrete* [abehi] / *rubber* [bcdegij] / *soil* [c] / *sand* [cf]. Hay can be put on top of the concrete to offer a softer place to lay down (IRKA, 2010a). No extra bedding material is needed if hay is offered in abundance on the floor of the pen. Pens that house calves should be furnished with more hay than is eaten. (Goltenboth *et al*., 2001)

It is advisable to install floor heating [cdefgi]. / *Floor heating is not good for the animals* [abh]*, since floor heating can dry out the hooves of the animals* [h].

For the outside enclosure a self-draining surface that provides adequate footing is recommended (Goltenboth *et al*., 2001). The substrate in the outside enclosure should be made out of a combination of *grass* [abcdefghij] / *sand* [abcfghij] / *concrete* [bg].

In the quarantine area the substrate should be the same as in the normal enclosures [abhij]/ *In the quarantine area the substrate should consist out of materials which are easy to clean, such as sand and concrete* [cdefg].

2.1.5 Furnishings and maintenance

Furnishings

Furnishings are installed into the enclosure to increase the natural behaviour and reduce stress levels. Also for management purposes additional furnishing can be installed like a scale or separation walls.

White rhinos need a pond and/or mud wallow (see figure 9) for skin health, temperature regulation and behavioural enrichment [abcdfghj]./ *White rhinos are less likely to use ponds since they don't swim, so pools are not necessary and can sometimes be a hazard if they are deep* [e]. (IRKA, 2010c, Goltenboth *et al*., 2001). / *Mid deep mud banks and natural ponds are sufficient* [i]. The white rhinos will construct their own mud wallow when given a start. A mud wallow needs to be renovated *once a year* [abgh] (Goltenboth *et al*., 2001) / *at own insight* [bcdefij], to prevent the mud wallow from getting too big and too deep. When a pond is constructed it should have a depth of max *0.5* [abh] / *0.7* [bdij]/ *1.0* [c] m.

Figure 9. Two white rhinos bathing in a mud wallow

Access to shade and protection from rain is a must. By giving shaded areas to the white rhinos they can rest in cooler areas during the hotter periods of the day or when the stable is inaccessible [abcdefghij] (Goltenboth *et al*., 2001). Possible options are trees and/or other vegetation, and roofs as artificial means. It is recommended that a number of adequate sun and rain protection zones are provided. Sun shelters can also be usable as rain shelters, trees do rarely serve this purpose. In some part of the enclosure wind protection should be provided, unless a solid wall barrier already exists (Goltenboth *et al*., 2001).

White rhino facilities need interconnecting sheds made out of solid walls (concrete or wood are acceptable materials) to prevent visual contact between individuals (Goltenboth *et al*., 2001). It is important that visual barriers are present in the enclosure, so the rhinos can escape from each other's eye sight [abcdefghij]. Also visual barriers between rhinos and other animals are needed. Table 8 shows an overview of species that should be separated by a visual barrier. There should never be direct visual contact between pray and predator [i].

Table 8. Visual barriers needed

Groups	No barrier	Partial	Complete
Carnivores	X [adf]	X [cegj]	X [bhi]
Birds	X [adefhj]	X [cgi]	
Herbivores	X [adefj]	X [cghi]	
Visitors	X [adf]	X [bceghij]	

Maintenance

Easy maintenance of the enclosures is worth considering when planning enclosures. Well-constructed enclosures are easier to maintain and are subsequently more likely to be responsible managed (Rosenthal and Xanten, 1996).

The indoor housing should be cleaned every day [abcdefghij]. This should be done with *disinfectant* [ah] / *soap* [a] / *high pressure hose* [abdeij]. It should get mucked out daily but not pressured hosed on a daily basis [b].

The outside enclosure should be cleaned *every day* [c] / *twice a week* [afh] / *once a week* [dg] / *when needed* [eij]. This can be done with a *pick-up* [ab] / *shovel* [ab].

The enrichment objects should be cleaned *every day* [h] / *twice a week* [bfg] / *once a week* [ad] / w*henever needed* [ij], especially if kept with other species [c]. This should be done with *disinfectant* [h] / *soap* [a] / *high pressure hose* [*bdeij*].

2.1.6 Environment

Temperature

White rhinos in captivity live in a variety of climates. In cooler climates a heated stable with enough room for exercising is needed (IRKA, 2010a). White rhinos should have access to their inside enclosure when the temperature is *<1* [b] / *<5* [fghj] / *<10* [a] °C. When there is rain, snow or hail at a temperature of respectively (*<1* [d] / *<5* [aj] / *<10* [befghi] °C), *(<1* [di] / *<5* [hj] / *<10* [befg] / *>10* [a] °C), *(<1* [d] / *<5* [j] / *<10* [abefgi] °C) the rhinos should go inside. With hard winds and a temperature of *<1* [de] / *<5* [bj] / *<10* [fghi] / *>10* [a] °C the rhinos should go inside. Snow and cold are not harmful for healthy rhinos but wet and cold/windy conditions are [c]. A minimum outdoor temperature of 12 ºC is required, to let the rhinos stay outside (Goltenboth *et al*., 2001).

The temperature in the stable should be at least *14 °C with the capability of maintaining some areas at 20 °C* [*abcdeghj*] */ 16 -17 °C* as maximum [i] (Goltenboth *et al*., 2001). For sick or older animals the inside temperature should be a little higher than for healthy white rhinos [abcdefghij].

Heating should be available whether floor or radiant heating. *Floor heating is good for young and old animals* [e] / *Floor heating may cause problems by raising dust and ammonium fumes and should be restricted to cover no more than one quarter of each pen* (Goltenboth *et al*., 2001). / *Floor heating is recommended only if rubber or concrete is used and it is easy to dry the surface* [c]. The temperature of the floor heating should be around *10* [de] / *12* [i] / *14* [bh] / *18-20* [*g*] ºC.

Humidity

The humidity in the stable should be kept between 40 – 70 % [abcdefghij].

Ventilation

Adequate ventilation must be available. *Natural ventilations* [abcij] / *Fan ventilations* [dehj] / *Air exchangers* [fg] are recommended, including exhausters *in the roof* [acdfj] / *in the walls* [ei] / *near the floor* [bgh] for effective removal of ammonium fumes. Draught should be avoided. (Goltenboth *et al*., 2001)

Lighting

It is recommended that the period of (day) light be kept at 12 h, also during the winter months (Goltenboth et al., 2001). The lighting should consist of natural lighting [abcdefgij] / *artificial lighting* [bcdeg]/ *TL lights* [g]. The use of UV lamps depends on the type of lamp and the distance to the animal. This is important for young animals with regard to bone structure. In winter UV-therapy for 1 hour can help to prevent problems [g]. The lux index should be between 950-1000 lx [h].

Quarantine

When designing a quarantine area, the following aspects should be kept in mind; disinfection of the floors should raise no problem, the floor should not be slippery, floors of well-draining tiles that also hold back water are recommended, rubber matting for hoofstock may be used (Goltenboth et al., 2001). An easy way for waste removal [b], extra heating for sick animals, independent water and drainage [c], take samples without sedation and ease of cleaning and self-contained for staff and animals [d] are important.

2.2 Feeding

A diet should always be balanced and contain the required energy and nutrients. The age, sex, reproductive status and general health of every individual animal should be considered when designing a nutritional program. Therefore the basic diet, special dietary requirements and non-nutritional aspects of feeding as well as methods of feeding and information concerning water supply are described. In §1.2.2 diet and feeding behaviour of the wild white rhino can be found. "The software programme Zootrition should be consulted where possible to analyse nutritional quality and quantity of food consumed and wasted" (EAZA husbandry guidelines format, 2008).

2.2.1 Basic diet

As stated in Section 1, the white rhinoceros is a grazing mega-herbivore (Owen-Smith, 1988), which means that they eat large amounts of short grasses and no browse at all (Steuer *et al*., 2010). It is rarely possible to provide natural grass species in captivity and therefore a good understanding of the nutritional requirements of white rhinoceros is necessary when formulating captive diets. In the wild, white rhinos select a diet that has a high fibre content and a low to moderate protein content (Clauss and Hatt, 2006). On average a white rhino should spend *3-6* [abfhi] / *6-9* [ej] / *9-12* [dg] hours on foraging/feeding (see figure 10), but this strongly depends on the time of year [f].

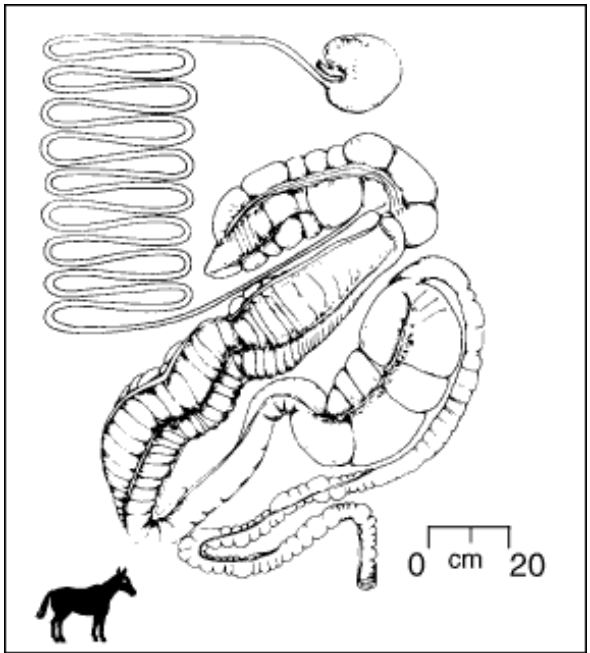

Figure 11. Domestic horse (*Equus caballus*) digestive tract

Nutritional content

Due to similarities in digestive tract morphology, the domestic horse (figure 11) represents the best nutritional model for all rhinoceros species (Stevens and Hume, 1995). Diets should be formulated using current recommendations for horses of various physiological stages [abdefghij], however, there are reported differences in the requirements of fat soluble vitamins [j].

Figure 10. White rhinos grazing in Greater St. Lucia Wetland Park, South Africa

According to the experts, the food items listed in table 9 can be given to white rhinos, but Clauss and Hatt (2006) stated that there is no nutritional or financial rationale for offering fruits or vegetables to white rhinoceros. "If a fruit component of the natural diet is to be mimicked for pedagogic or emotional reasons, then commercially available green leafy vegetables best resemble 'wild fruits' in their nutritional composition. Onion, brassica and rape should be avoided, as they have all been linked with haemolytic anaemia in other species." (Clauss and Hatt, 2006) "An adult white rhinoceros of 1800 kg can cope with a daily intake of some 25-35 kg of dry matter. The high moisture content of fresh foods would mean that four times this weight would probably be consumed in a 24-hour period." (Jones, 1976) "Commercial fruits, vegetables, cereals and grain products should not be fed, except for medication or training purposes, although even in these cases, green leafy vegetables are to be preferred" (Clauss and Hatt, 2006).

Table 9. Food items and quantities per adult white rhino per day

Food item	Quantities per adult rhino (kg)	Reference
Hay	? – ? – Ad libitum – 2 to 3 bales (50 to 75 kg)	a – d – begij – h
Lucerne	–	c
Alfalfa hay	30-40 kg	h
Grass	? – ? – Ad libitum	a – f – e
Rye	–	c
Clover	–	c
Avena	–	c
Fruit	? - 2	a – b
Apples	20 kg – 1 to 2	h – (Goltenboth *et al.*, 2001)
Vegetables	2	b
Carrots	? – 1 to 2	c – (Goltenboth *et al.*, 2001)
Beetroot	–	c
Beta vulgaris	–	c
Mixed chopped carrot / celery / turnip / kohlrabi	20	h
Pellets	1.2 – 6 to 8 – 4 – ? – 10 – 2 to 8 – 1 to 3	b – d – e – g – h – i – j
Dry bread	–	a
Flaked maize	–	d

Quantity, quality and frequency

Because of the large amounts of grass eaten by white rhinos, lower quality grass is tolerated in comparison with smaller herbivores (Owen-Smith, 1988). "Maintenance requirements of hindgut fermentators should be 0.6 MJ digestible energy per 0.75 kg metabolic body mass" (Clauss and Hatt, 2006). Dierenfeld (1999) stated that dry-matter intake in an adult rhinoceros ranges from 1 to 2.5 % of body mass in zoo studies. Approximately 1.5% of body mass (on a dry matter basis [j]) is advised [bdefghij]. This varies per season [c].

Food should be offered *twice* [abdeghj] / *three times* [ci] a day with constant access to grazing (depending on seasons). Hay must be available ad libitum and stored *at the same temperature as surroundings and dark* [acefgh] / *at the same temperature as surroundings* [bdij] prior to feeding. "Rhinoceros are prone to obesity and food should be given restrictively, based on either the results of regular weighing or regular assessment of the body-condition

score. Changes to the amount of roughage offered should be accompanied by corresponding changes to the amount of pelleted compound feeds offered" (Clauss and Hatt, 2006).

Roughage

Hay of appropriate quality should be the major part (in quantity and nutrients) of a white rhinoceros diet [abcdeghij] (Clauss and Hatt, 2006). The quality of hay needed depends on the availability of good grazing [e] and the amount of concentrate fed [f]. Care should be taken with very high quality legume or small grain hay, as it is very easy digestible [j]. Hay quality should be *monitored by laboratory analyses* [abcdefghj] / *judged by sight* [i] / *known by origin* [c] to ensure appropriate quality and to determine what additional nutrients are needed for a balanced diet, but is rarely practical [d]. Hay should be tested only for evidence of selenium content [j]. According to Clauss and Hatt (2006) grass hay is the appropriate roughage for white rhinos but to ensure adequate protein levels, 20% of the hay offered should be legume hay. In §1.2.2 the twenty most consumed grass species in the wild are listed. Suitable plant species for feeding are *most non-evergreen tree species* [b], / *browse* [dgj] *like willow, silver birch, sycamore* [d] / *grass* [cdefgj] / *hay. All evergreen plants* [b] *like Taxus* [cd], / *some non-evergreen plants* [b] *like young Quercus* [d], *Robinia pseudoacacia* [c], / *Senecio* [dh] / *and potatoes and cabbage in great quantities* [f] should not be fed.

Pellets

Concentrate feeds should only be used to balance energy, protein, minerals or vitamin needs [abcdeghij]. / *Less quality hay will do as long as a sufficient concentrate is used* [f]. "It should only be used to satisfy energy needs when adequate roughage is not available. There is no scientific rationale for the inclusion of grain products in pelleted compound feeds for strict herbivores" (Clauss and Hatt, 2006). Alfalfa pellets are not recommended (Goltenboth *et al.*, 2001). Not more than one-third of the overall calories should come from pellets [abdefghij] according to Dierenfeld (1999). Large horse feeds or high-fibre ungulate pellets (>1.0 cm diameter) work well with white rhinos [abdefghij]. *Pellets should be given in at least two feedings daily for better utilization and, when practical, a small feeding of hay should be encouraged prior to each concentrate feeding* [abdfghij]. / *There is no need to feed hay before each feed* [b] *and is not practical in many cases* [j].

Supplements

Dietary supplements are unnecessary in properly formulated rations [abcdfgij]. / *Daily vitamin E supplement is necessary* [bj]. Salt blocks *should* [cdfij] / *should not* [abegh] always be available.

Calcium (Ca) and phosphorus (P)

"A diet based on any hay (grass or lucerne), supplemented with pellets, does not require any additional calcium source" (Clauss and Hatt, 2006). Differences in calcium levels in forage in the natural diets of white rhinoceros are shown in table 10.

"Roughage based diets are particularly vulnerable to phosphorous deficiency. Hypophosphataemia (low levels of phosphorus in the blood) has been observed in rhinoceros with haemolytic crises, so a deficiency of this mineral in the diet should be avoided." (Clauss and Hatt, 2006)

Copper (Cu) and Zinc (Zn)

Clauss and Hatt (2006) stated that some diets for rhinoceros are deficient in copper. Further research into copper metabolism in white rhinos is needed. Zinc deficiency may lead to the development of skin and foot lesions, so zinc should be supplied according to the domestic horse recommendations (table 10) (Clauss and Hatt, 2006).

Table 10. Mineral content (in g/kg DM) of the diet of free-ranging white rhinoceros as compared to temperate lucerne, grass and recommendations for maintenance requirements in domestic horses

Mineral	Temperate		Recommendations maintenance level	
	Lucerne	Grass	Rhino	Horses
Ca	21.0	4.8	2.4	2.4
Cu	0.011	0.006	0.004	0.01
Fe	0.180	0.129	0.177	0.04-0.07
K	22.0	21.6	8.5	3.0-6.0
Mg	2.8	1.5	0.8	0.9
Mn	0.040	0.074		0.04
Na	1.1	0.05	0.3	1.0
P	3.0	2.7	1.0	1.7
Zn	0.024	0.019	0.023	0.04

2.2.2 Special dietary requirements

As said before, a diet should always be balanced and contain the required energy and nutrients. The age, sex, reproductive status and general health of every individual animal should be considered when designing a nutritional program.

During pregnancy the dam gets *the same food items and amount as normal* [abcefghi] / *the amount should be increased in the third trimester* [d] / *an increase in concentrates and in the last trimester an increase of vitamin A and D* [j]. An increase in food can cause problems with the calf getting too big [b]. Multivitamins [c] and herbs [g] could be offered.

During lactation the dam gets *the same food as normal* [acgi] / *an increased amount of food* [d] / *an increase (of 100%) in concentrate pellets* [bej] / *more energy in the form of carbohydrates and protein* [f] / *a raised ration of the juicy, sappy food items* [h] / *an increase of vitamin A and D in the last trimester* [j]. Not enough protein in the diet may cause muscle loss in lactating females [b]. Also multivitamins can be added [c].

After weaning, the dam gets the same food as normal [abcdefghij]. This should be done by gradually reducing the diet amounts back to normal [bj] and monitor milk production [d].

The calf should *get the same food as an adult* [abcdeghi] / *with better quality hay* [f] / *and a nutritionally complete pellet (higher digestible energy, vitamin A and crude protein) and alfalfa hay* [j] after weaning but in smaller quantities. Creep feeders can be used to separate the calf [d].

"Hand rearing of rhinos is executed in accordance with the known procedures for other species. Hygiene is an absolute must to avoid contamination of the milk, as well as intensive care by one or more keepers. The applied milk preparation should simulate the natural mother milk. Skimmed, pasteurized or homogenized milk (3.2% fat, 3.3% protein, and 4.7% lactose) is well suited. Supplementation of vitamins and minerals is recommendable. If possible, colostrum should be given within 24 hours after birth, alternatively rhinoceros serum. For hygienic reasons and to avoid hasty drinking the young should rather be bottle fed than with a bucket." (Goltenboth *et al.,* 2001) "Quantity fed should range from 10 to 13% of body weight. Animals should be fed every 2 hrs. Because infants suckle during daylight hours, feeding should be equally spaced in a 12-hr period not to exceed 3% of body weight at any one feeding. It is recommended that feeding begins with 10% of body weight split equally

into 12 feeds 1 or 2 hour apart during daylight hours. The quantity of formula fed should be adjusted daily based on the animal's weight. Animals should be weighed at the same time each day. Fresh water should be available at all times." [abcdfghij] (Fouraker and Wagener, 1996). "Weaning animals should have access to solid food at all times. A nutritionally complete pelleted diet such as horse feeds or high fibre ungulate pellets, in addition to alfalfa hay, is appropriate. Formula may be decreased by gradually elimination the number of feeds or decreasing the amount offered per feed and gradually decreasing the number of feeds." [abcdefghij] (Fouraker and Wagener, 1996)

Pedersen (2009) states that grass quality changes as seasons change. More high quality grass is available in the wet season. In addition, white rhinos select grasses by the availability and palatability which is also affected by seasons. The quantity and quality of the food in captivity *should* [abcdfgij] / *should not* [eh] be altered in 'dry periods' to imitate natural fluctuations.

2.2.3 Method of feeding

To avoid ingestion of sand, which can cause colic, white rhinoceros should not be fed on sandy ground (Clauss and Hatt, 2006) but inside *on the floor* [abcefghij] / *in racks* [d] / *on concrete* [j] and outside *on the floor* [acfij] / *in racks* [ahi] / *on a concrete pad* [abdegj] / *in livestock troughs* / *in bins*.

Schmidt and Sachser (1996) researched food dispersal and behaviour in white rhinos. They found more agonistic encounters when hay is provided in one pile for all animals, in comparison to one pile for one animal. "Stress-hormone levels were elevated during clumped feeding and agonistic behaviour continued to be observed long after the hay was consumed." These results underline the importance of providing an appropriate number of feeding places for animals that are maintained in social groups. Depending on size of feeding stations [e], the number of feeding stations outdoors should be *more than* [bcfj] / *the same as* [adh] / *less than* [egi] the number of individuals. These feeding stations should be far away from each other to minimize stress and competition [gi].

2.2.4 Water requirements

White rhinos can live up to 4 - 5 days without water (RRC, 2010), but a fresh water source at room temperature should be accessible at all times (Goltenboth *et al.*, 2001). *Troughs* [egi] / *Automatic drinking troughs* [abcdfhj] are the best ways to provide drinking water indoors to white rhinos. Outdoors *troughs* [i] / *automatic drinking troughs* [acdhj] / *a moat or pond* [bcefg] should be used. Self-operating water sources cannot be recommended (Goltenboth *et al.*, 2001). Make sure the horn does not obstruct the drinking behaviour of the rhino [g].

2.3 Social structure

In the chapter social structure, topics as group composition and introductions are discussed. When animals are introduced into an existing group the introduction can be stressful for animals and keepers. To keep stress levels as low as possible certain steps can be taken. Especially with mixed exhibits the introduction can be troublesome. You need to know which animals can be mixed and which cannot live together in one enclosure.

2.3.1 Basic social structure

An optimal sex and age structure for a new group would be 2.3.3, which contain one sub adult male and one sub adult female (Pienaar, 1994). Evidence from captive white rhinos in zoos indicates that cows do not come into oestrus if there is only one bull (Lindeman, 1982), although this is not always the case in free-ranging populations. It is always a good policy to have at least two bulls in a population just in case one gets injured (Pienaar, 1994). *The optimal group size is 2.3 adult animals* [abdgij]*/ 2.3 white rhinos isn't the optimum group size* [cfhe]. If the space is available, more females are always ideal [b] and both males can be offered a separate territory [i]. Holding one or two individuals should be avoided [d]. When breeding is happening the group size is good. Temperament and age of the animals are important factors [f]. If two males are kept together it can have a detrimental effect on sperm quality [h].

Males can be housed alone but appear to prefer to be housed with at least one female. Females are housed with at least one other female if no male is present, depending on the size of the enclosure. (IRKA, 2010)

At an age of *2-3* [abdf]*/ 3-4* [*ceghij*] years white rhinos are ready to be taken out of their old group and can be introduced into a new group. Until a calf is about 3 years old it should be kept with its mother. If an animal is introduced too young, it is possible it will look at the other rhino's as siblings and breeding will not occur. There is also a chance of social suppression; the young animal will be socially suppressed by the older females and become a flat liner [g].

2.3.2 Changing group structures

A flexible rotation system where the group composition differs each day gives the white rhinos stimulation [i].

When extending the group structure it is necessary to provide ample space and hide-outs.

The most important element in introducing individuals for breeding is the age factor and social status, which should harmonize. For instance, a sub-adult male will not know how to approach an adult female, subsequently the female will fight or intimidate the male. A proven breeder under normal circumstances will breed with a young female. However, it should be noted that successful introduction of individuals is largely dependent on the introduced animal's personality [b]. Either sex of captive individuals have shown aggression on introduction. (Goltenboth *et al*., 2001) For 'training' a young male may be introduced to a young female, whereas an older male will be brought into action to fertilize her. (Goltenboth *et al*., 2001) Female calves may stay in the group, male calves can stay as long as they are tolerated and do not mate with their relatives.

Introduction

When an animal needs to be introduced to a group, it is important that the introduction is done gradually.

During an introduction of an animal, the following steps may be taken:

- Provide auditory, olfactory, and visual contact between the newcomer and the herd [behj]

- Provide tactile contact through bars with a few members of the group
- The individual is introduced to either the dominant animal or the entire group.
- During introduction a veterinarian as well as experienced staff members should be present with a high pressure water hose. (Goltenboth *et al*., 2001)

All animals should independently get to know the enclosure and each other through bars. It is recommended to first group the females and to introduce the male later. On introduction all animals will show the same known behaviour patterns like aggression, greeting, fighting, and bluff charging. The newly introduced animal may show fear and develop diarrhea. (Goltenboth *et al*., 2001)

During the introduction the following signs are good indicators that the new animals are ready to be introduced into the rest of the group: *reduced aggression* [d] / *flehming* [c] / *feeding normally and lying down* [f] / *relaxed, friendly, curious behaviour* [gi]. Social suppression should be kept in mind when introducing new animals [g]. Integration is reported to take between 1 to 10 weeks. (Goltenboth *et al*., 2001) Excessive aggression [abcdefghij] is a signal that the introduction is not going according to plan and that it can go wrong. When this happens it is best to isolate the new animal and maybe try later to introduce it again. (Goltenboth *et al*., 2001) *A distraction during the introduction is a good idea to calm the animals down* [abcdefghi]/ *It isn't good to distract the rhinos from each other during an introduction* [j]. Food for example would calm the animals down.

Table 11. To whom should the new animal be introduced first, in a group

	Single female	Group of females	Single male
Young male	X [adg]	X [bcefhij]	
Adult male	X [adegij]	X [ch]	X [bf]
Young female	X [abdefghi]	X [cj]	
Adult female	X [abdefgij]	X [ch]	
Female with calf	X [abdefgij]	X [ch]	

Introducing a female in a female group (table 11)

Prior to first contact the female should be familiarized with the outdoor enclosure. Indoors females should have eye contact through bars. Before the final introduction they should no longer show aggression. Introduction while a female is in oestrus can be beneficial [fgi]. Close observations should be continued after the introduction. (Goltenboth *et al*., 2001)

Introducing a male to a female group (table 11)

Male rhinos are territorial, they mark their territory with faeces and urine, scraping hind legs and spreading dung. A male's marking should not be removed prior to introduction of the female group. Females tend to form strong pair bonds, also if not related. In some cases this has interfered with breeding, when the female's cage mates keep driving off the approaching male. A second male kept in an adjacent enclosure may stimulate breeding through potential competition. (Goltenboth *et al*., 2001) The second male can be hold in the surplus area and when necessary be introduced to the group of females for mating.

Upon introduction of a male to a group of females, the females should be together and comfortable. The new male will exhibit aggression, greeting, bluff charging and fighting. The females in return will show the same. (Goltenboth *et al*., 2001)

It *is* [bfh] / *it is not* [acdegij] a good idea to do a male-female [h] introduction while a female is in oestrus. This depends on the animal which will be introduced. If a male gets introduced it isn't a good idea [fgi]. Integration is reported to take 5 weeks (Goltenboth *et al*., 2001).

2.3.3 Sharing enclosure with other species

There are advantages to keep white rhinos in a mixed species enclosure for *educational* [bceg] / *and behavioural enrichment* [abcdefgij] reasons. The educational value is that the visitors can see the rhinos with other species which live in the same habitat. The enrichment factor for the animals is that they can be distracted by the other species [i].

Sharing species

The following species are known to be kept with white rhinos (see figure 12): mongooses [a], monkeys [a], (plains) zebras [abcdefghij], giraffe [bdefghij], crowned cranes [bch], ostrich [beh], duck [ch], geese [ch], eland [acdefhij], ankola [acdefhj], lechwe [acdefhj], camel [defh], cheetah [ei], ostrich [ehj], waterbuck [acefgh], wildebeest [acdefghj], greater kudu [abcefgh], springbok [acefhi], blesbok [acefhi], watussi [efhi], nyala [acefhi], (congo) buffalo [efhij], gemsbok [acefhj]. When there is breeding going on in the enclosure there should be enough space and refuge possibilities (Goltenboth *et al*., 2001).

Separated species

There are some species that can't be held in the same enclosure as the white rhinos, these are: lions [c], elephants [efh] addax [j]. Zebra stallion [b], wildebeest bulls [d] and giraffe bulls [gi] might be dangerous to keep in the same enclosure.

Figure 12. Rhino, ostrich and zebra in one exhibit

2.4 Breeding

"Breeding is an important component of conservation, with the captive populations serving as potential reservoirs for reintroduction animals into the wild. However, reproduction in white rhinoceroses, especially those in captivity, has been distinctly disappointing. Reasons for this are still unclear. The understanding of the reproductive biology of the white rhinoceros is still limited and details are largely unknown." (Goot, 2009) "Many of the founding population, given appropriate husbandry and management, reproduced well, but reproduction among captive-born females has been extremely sluggish" (Swaisgood, 2007). This chapter outlines breeding, including details on mating, pregnancy, birth, development and care of young and procedures involving hand-rearing. The contraception policy is also described. See §1.2.3 for more reproduction information.

2.4.1 Mating

White rhinos are aseasonal or opportunistic breeders (Skinner *et al.*, 2006). This results in the possibility that a calf can be born all year round. Both genders need to be sexually aroused. By rotating females to different bulls and the bulls not having constant access to the cows a sexual tension field is created [cgij]. When a cow approaches oestrus *there are no noticeable signs* [acgh] / *the noticeable signs are male interest* [bej], / *squirting urine* [dij], / *vulva wink* [ij], / *aggression* [dj], / *cloudy urine, restlessness, inappettence* [d] / *standing still* [f]. Faecal analysis on hormone levels can be done in Vienna (Dept. of Natural Sciences - Biochemistry University of Veterinary Medicine) [g]. The following behaviours are commonly seen during courtship: male constantly following female around [bdefij], approaching [h], spray urinating [c], smelling at urine and faeces [cd], over-marking [c], male smelling females' back end [b], dragging [c], flehmen [cgij], vocalisation [cgj], body and horn rubbing and pushing [c], ambivalent behaviour [fg], erection [e], mounting [eh], chin resting [eij], heavy breathing [g], female standing still [ij], female back up to the male [j] and frequent urinating and wetting herself [i]. With ambivalent behaviour the danger of separating too early is present. To ensure positive breeding results, the optimum male : female ratio of a breeding group should be *1.3* [cefhj] / *2.3* [abdgi] although multiple males may be detrimental to each other [e]. "Copulation lasts for 30 minutes or more and will occur several times at the peaks of oestrus. A male remains mounted for 19 minutes or much more" (Goltenboth *et al.*, 2001).

2.4.2 Pregnancy

White rhino females can have two different reproduction cycles. One female can have a monthly cycle and another female a bi-monthly cycle. The difference is the length of luteal phase (Patton *et al*, 1999), so the time between pregnancies can differ.

A pregnant white rhino *has gained weight* [abcdgj] / *undergoes physical changes* [ghj] *like swollen vulva* [gj] *and udder* [ghj], *small bladders around vulva filled with liquid short before parturition* [g]. /

Figure 13. IZW scientist Dr. Robert Hermes confirmed the pregnancy of the white rhino by carrying out a sonography

She can also undergo behaviour changes [abcdfghj] *like less tolerant toward herd mates* [bj], *avoiding the male and aggression* [d] *no more copulations from male* [e]. A *hormone level test* [abcdfghi] or sonography (see figure 13) are recommended to confirm pregnancy. When a female is pregnant the special husbandry adjustments in table 12 need to be implemented.

Table 12. Special husbandry adjustments during pregnancy

Husbandry adjustment	Reference
Nothing	efgj
If male is threatening female, they should be separated.	a
Not overfeeding the female. To monitor behaviour and separate female from others if becoming stressed or less tolerant.	b
Privacy in night quarters.	c
Calcium supplement. Close down gaps in vertical bars. Deep litter calving pen. All round keeper access if possible and reduce water level in trough.	d
The bull should be separated in order to avoid possible aggression during the pregnancy.	h
The female should be used to stand separately prior to birth, in a stable with bars in between her and the group. It is important that she is not isolated from the group but does have more relaxation on her own.	i

Artificial insemination

When natural reproduction cannot occur or doesn't result in viable offspring, artificial insemination (AI) can be a solution. The first successful AI in a rhinoceros was reported in 2007 using fresh semen. The first successful artificial insemination with frozen-thawed semen in rhinoceros holds great promise for the future of these mega herbivores. Semen samples can be collected and preserved from both wild and captive populations. (Hermes *et al*, 2008) Artificial insemination *is* [bcdefghij] / *is not* [a] an option when breeding is desirable. Nevertheless natural breeding is best, so AI is an option only after exhausting other possibilities [bfghi]. Please make the best use of the information and expertise of the IZW (Institute for Zoo and Wildlife Research) [d].

2.4.3 Contraception

Managing a rhino so that it is unable to breed is the only form of contraception at this point in time (e.g. separation and/or transport). The choice has been made that birth control, in the form of surgery, hormone suppression, etc., is not an option for this species because of the low population numbers in European institutions. Breeding is desirable to get a viable and stable ex situ population. Managing the individual white rhinos in a way that they can be used optimal for the breeding program is of vital importance. (Versteege, 2010b)

2.4.4 Birth

When a white rhino female is at the beginning of parturition she will retreat to a quiet place [adefghj], refuse to eat [dfg], urinate frequently [adfhj], pace [abcdgh], getting up and down and generally looking uncomfortable [b], swelling of the udder and vagina, discarding of mucus, defecating [cg], twisting of the tail in an upheld position [h], like in a horse hard drops of excretion from udder, many females show different behaviours. Dropping of progesterone level is a good sign that

within 36 hours the calf will be born [i]. When these signs are seen the female should *stay in the group* [bc] / *be separated from the group* [abcdfhi] but no isolation, with bars in between female and the rest of the herd. Judgement can be made on site [bcegij]. When the female is separated *no* [gi] / *olfactory* [abcdej] / *auditory* [abcdej] / *visual* [adj] / *physical* [fhj] contact with the male and *no* / *olfactory* [abefij] / *auditory* [abefij] / *visual* [abcefij] / *physical* [cdhij] contact with other females is recommended.

The birth *should* [bcdefhij] / *should not* [ag] be observed by a *person* [j] / *camera* [bcdefhij] to monitor the process.

"Delivery (see figure 14) is of short duration; labour about 40 minutes, parturition time about 10 to 20 minutes (either standing up or lying down). On a normally, delivery occurs in the evening or at night. For the infant to be able to stand up it is necessary to prepare a none-slippery floor surface. The placenta will be discharged right after giving birth and in many cases will be ingested by the mother. Suckling is done either standing up or lying on the side. The latter may result in the infant to fall asleep. First nursing is seen within less than 1 hour or within 24 hours after birth. First standing up by the infant is commonly seen after 15 minutes. It may however take 1 to 2 hours." (Goltenboth *et al.*, 2001)

Figure 14. A southern white rhinoceros gives birth to her calf in Budapest, Hungary

"Whenever possible, neonatal examinations should be performed. These should include weight, a dipstick blood glucose, total solids, CBC, sera chemistry profile, sera/plasma for vitamin-E levels, and, when possible, stored sera. Examinations may include vitamin supplementation and the placement of an identification transponder." (Fouraker and Wagener, 1996) [acdhj] *Neonatal exams should only be performed in case of emergency* [bg] *or only some exams* [befgi] like storing sera [c], visual check [e], weight checks in the first weeks. The identification transponder could be placed at this time [g].

2.4.5 Development and care of young

To prevent the dam from killing the calf *a calm environment* [bceh], *routine* [bceh], *close observation* [abd], *all round keeper access to the pen* [di] *and enrichment* [j] is recommended. When everything goes as planned the calf can be introduced to the male/herd in *2 weeks* [abcdeghij] / > *2 weeks* [fi] after birth. This depends on temperament of the female and its relation to with the male [bg], and also on the temperature (harsh European winters) [d]. If the mother neglects her calf the best solution to help the calf is to *hand-rear* [dhj] / *foster* [ag] / *foster and hand-rear it* [bcf]. When hand rearing is necessary, it's best to do this near the mother or other rhinos [g].

2.4.6 Hand-rearing

"Hand-rearing (see figure 15) becomes necessary if the young is rejected by the mother, if medical problems exist in the mother or the infant, or if the infant fails to nurse. Hand-rearing an infant must be considered very carefully. Should the female show aggression toward the young or have medical problems, hand rearing must be considered." (Goltenboth *et al.,* 2001) See §2.2.2 for feeding instructions.

Figure 15. Keeper bottle-feeds white rhino calf

2.4.7 Population management

For a healthy ex situ population the target population for the white rhino is set on 450 animals by the EEP (Versteege, 2010b). "Analyses of the 2006-2007 EEP population indicated that more than 30% of the population is more than 35 years old, but that only 26% of the white rhinos imported since the 1950s ever bred, and only 13% of the F1 generation has bred to date. More recently, a much better understanding of the natural history of these animals has resulted in improved management. Zoos holding white rhinos within the EEP are now strongly encouraged to hold larger groups. The realization that reproduction of daughters is hormonally suppressed in the presence of their mothers has led to transfer of female offspring to other zoos, increasing their chance of breeding. Much of the population is aging and not much breeding is occurring." (Versteege, 2010a) Breeding white rhinos is needed for a stable, self-sustainable population. Non-breeding specimens should be assessed [d]. In 2001 the EEP committee recommended that the birth interval for white rhinos should be no less than 4 years. For extensive groups the birth interval depended on the individual animal, because normally mother and calf are not separated. (Goltenboth *et al.,* 2001) In a multi-male group, incomplete dominance of the males and interference from other males during mating can result in a reproductive failure. The solution is to maintain one male with the females and separate the remainder as a bachelor herd. (Seror *et al*., 2002)

2.5 Behavioural enrichment

Captive environments are considerably less complex than wild environments and confined animals can show boredom in response to an enclosure that fails to stimulate their wild behavioural needs. It is difficult to define the stimulatory needs of an animal as these vary between species and even between individuals. To maintain wild behaviour in captivity it is essential to adapt captive conditions to the animal with behavioural enrichment rather than expecting the animal to adapt to the environment. (Carlstead, 1996) This chapter provides an overview of possible methods of behavioural enrichment for captive white rhinos. The response to the methods used for enrichment varies from individual to individual. Thus, the methods in this chapter are not a guarantee for success.

2.5.1 Rhino behaviour

Behavioural enrichment should suit the species specific needs and the physical build of the animals. As stated in § 1.1.3, white rhinos have strongly developed senses of smell and hearing (vocalisations are listed in table 13 below (Owen-Smith, 1973; Policht *et al.*, 2008). These senses are most suitable for white rhino enrichment.

Table 13. White rhino calls

Sounds	Call	Situation / meaning
Tonal sounds	whine*	begging for food
	squeak*	separation
Puffing sounds	snort*	no obvious
	threat	first warning
	puff	no obvious
Growling sounds	snarl*	aggressive
	grunt*	powerful warning
	grouch	foraging and other activities in proximity of other members of the herd
	groan	moan, body discomfort
Repetitive sounds	pant*	greeting, contact call
	hoarse	feeding, approach to female

*** = calls recorded also in Southern white rhinoceroses (Owen-Smith, 1973). Other calls of the Southern white rhino ("shriek, squeak, squeal, gruff squeal and gasp-puff") were not recorded in this study of Northern white rhinoceroses.**

<u>Stress, aggression and stereotypic behaviour</u>

Animals in captivity can display stress, aggression and stereotypic behaviour. The goal of enrichment is to minimize these behaviours by stimulating species specific behaviours. Behaviours that indicate stress in white rhinos are listed in table 14 (below). Aggression can be a result of stress, table 15 below shows how to minimize stress. The stereotypic behaviour displayed by white rhinos are *weaving* [c], / *extensive horn rubbing* [acg], / *pacing* [dfhij], / *bar biting* [fg], / *licking metal barriers* [g], / *rubbing* [h], / *abrasion* [h], / *lethargy* [j]. This is caused by *boredom* [bcdeghij], / *small enclosure size* [bdeghij], / *unable to escape other group members* [ancdegij], / *unable to display all the natural behaviours* [bcdfgij], / *stress caused by their environment (i.e. public, machinery)* [*beghij*], / *loneliness* [*a*]. *Refurnishing* [cdegij] / *changing contact moments (like variable feeding times, etc.)* [bcdefgij] / *training* [bcdefghij] / *enrichment* [bcdefghij] / *mixing with other species* [bcdefgij] / *changing group composition* [abdefgij] can be used to minimize stereotypic behaviour.

Table 14. Stress indicators

Stress indicators	Reference
Pacing	fghi
Change in normal behaviour	bj
Running or increased locomotion	eghi
Spending time away from the herd	dj
Aggression	dhej
Increased vocalisation and snorting	egi
Loss of appetite	bj
Reduced laying time	f
Unresponsive or quiet	j
Loose faeces and more frequent defecating	j

Table 15. How to minimize stress

Minimize stress by	Reference
Enrichment	cfhj
Enough space	aegij
Separate feedings	aegj
Individual pens	d

2.5.2 Types of enrichment

There are numerous ways to keep a white rhino occupied and encourage it to show its natural behaviours. The most effective enrichment type is *food enrichment* [bgij] / *scent enrichment* [acgj] / *item enrichment* [d] / *management (training, breeding, splitting up the herd)* [aefhj].

Food enrichment

Food enrichment, when used, should be part of a balanced diet to keep track of all the intake of the individual animals. When using food as enrichment for white rhinos, it is important to keep in mind that *food items used are taken off their daily diet allowance so they do not get overfed* [bcdefghij], / *you use food that is loved by the animals* [a], / *there shouldn't be any leftovers* [e], / *ratio rough-concentrate should be maintained* [if], / *no toxic plants or vegetables are fed* [gi]. The most suitable food for enrichment is *fruit* [abh] / *vegetables* [abgij] / *pellets* [abefj] / *hay or straw* [dj] / *bread* [i]. Other proven food enrichment are peanut butter, honey, pumpkins, watermelon, ice blocks (see figure 16), snow, corn syrup, molasses, alfalfa cubs and a non-regular diet (IRKA, 2010c). Check for toxicity §2.2.1.

Figure 16. A white rhino at Marwell Wildlife Park, UK, is inspecting a blackcurrant ice lolly

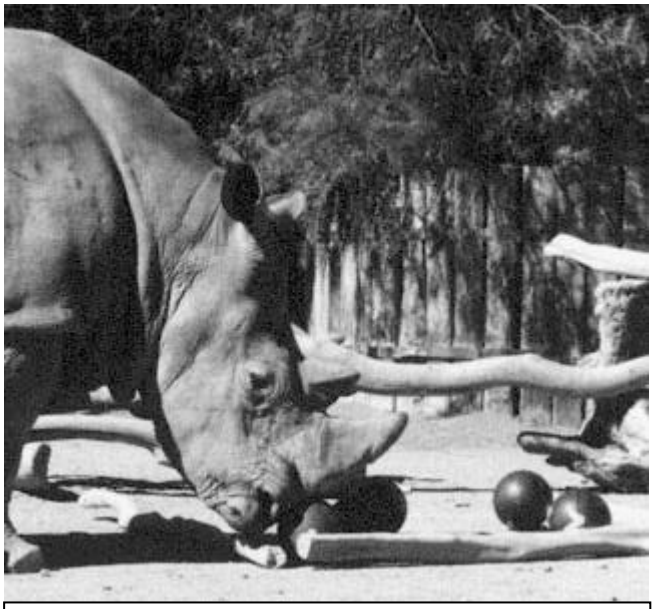

Figure 17. A white rhino in the Phoenix Zoo investigates the scented bowling balls

Scent enrichment

Hadley (2000) did a scent research by putting liquid scent extract on a sponge and put this in a bowling ball (see figure 17). She found that Southern white rhinos have little interest in the almond, coconut, Old Spice, vanilla, and vinegar scents. Two scents (banana and maple) had more interactions but peppermint had the longest duration and anise extract caused the highest total number of interactions. The behaviours to the scents included ignoring, looking near (within three feet), sniffing, rolling the bowling ball under his nose, rolling the bowling ball across the exhibit, mouthing the bowling ball, and marking (urinating on) the bowling ball. Hadley (2000) concluded that "any scents that are identified as favourites could be used in other forms of enrichment. For example, the scent could be placed on one or more of the logs, used to create a scent trail on the floor of the exhibit, or painted on walls in the exhibit. This may result in more exhibit exploration by the rhino, as well as encouraging natural behaviours like patrolling and marking territory." She also noted increased interest by zoo visitors, so this provided an excellent opportunity to further educate the zoo public about the natural history of the white rhinoceros, and to explain the purpose of enrichment.

Burrell *et al.* (2004) did a research on dung enrichment in black rhinos. They used dung from conspecifics and other ungulate species. They found a significant difference between frequency of faeces investigation on days with conspecific dung enrichment and baseline days. Other proven scent enrichment items are spices and herbs, cinnamon on hay, urine and dung, pumpkin pies, scented oils, cologne, fur and pinecones (IRKA, 2010c).

Item enrichment

A lot of objects can be used as enrichment for white rhinos. Suitable items are movable objects like tires, logs, stumps, balls, kegs, etc., rubbing posts, ponds and mud baths [abcdefghij] / *sprinkles* [bdeghij] / *loose, heavy chain fastened at both ends* [egi] / *logs suspended on chains* [adeghj] / *dung from other zoos* [acefgij]. Other proven enrichment items are boomer-, root-, soccer-, bowling balls, traffic cones, kegs, wind chimes, rubbing posts, hay bags, soap bubbles, leaf-, litter-, sand piles, spools, boat bumpers, car brushes, street brushes, hanging rubber mats, misters and showers, hanging hose, logs, sod, barrels, beer kegs, tires, cardboard boxes, wheel barrow bucket, carpet tubes, Christmas trees and bark (IRKA, 2010c).

Management

Enrichment doesn't have to involve putting items in the enclosure with the animal. It can be effective just by breaking habits. Rotating yards, shift to other stalls and howdy gates can be used as well as shifting rhinos into exhibit overnight, training (see §2.6.2), variable feeding times, semi-tactile contact with other rhinos on a variable schedule, moving exhibit furniture, splitting up the herd and playing recorded audio clips of other rhinos. (IRKA, 2010c)

2.5.3 Implementation

The power of enrichment lies in its novelty. Everything new is something to explore for the animal, but unfortunately, it works the other way around as well; the effect of enrichment fades away when enrichment is applied constantly or in a predictable setting. Enrichment should be available *once a day* [bg] / *1-4 times a week* [fhij] / *as many times as is possible* [e] depending on the type of enrichment [ag] and the available time of the keepers [c]. It also varies from individual to individual [dg]. The institution can choose for natural enrichment or unnatural enrichment. Both are effective but the strategy has to be in line with the institutions philosophy [d]. Observation is always important to assess how effective the enrichment is and to see if the enrichment is safe [g].

Enrichment can be applied in a number of ways, for example by pulley systems, ropes, in water, cables across the yard, chains, browse holders, bait tree, logs with holes drilled in it, buried, tire totem, scattered, piñatas, hay racks and rubbed on to things. Also involving the public (assistance) can be an asset for visitors, keepers and animals.

Regarding safety, things like sharp edges, broken zip lines, items suspended too low, throwing or launching items, chemical treated wood, breakage of ceiling lights, sky lights, ceiling fans, entanglement, barrier problems and impact on hot wire, food toxicity, door obstruction by free rolling items and water (seasonal indications) should be kept in mind. With regard to the safety of the animal it's important that the animal cannot injure itself [abfghij] or other animals [j]. (IRKA, 2010c)

2.6 Handling

This chapter contains information about identification, training, transport and safety. When keeping white rhinos, the keepers should able to tell the different rhinos apart. This is useful for management and/or medical reasons. When transporting a white rhino the stress levels should be kept as low as possible. By training the rhino, the animals can get familiar with the crate and the procedure of getting ready for transport. Special adjustments must be made to create a safe working space for the keepers and safe enclosure for the white rhino. Also the possibility of an escape is discussed.

2.6.1 Individual identification and sexing

The best way to identify white rhinos is just to get to know there external features [abcefgij] or use *a microchip* [bdhi]. Microchip brands that are used are: paddy-mark [b] and any ISO chip used in the EU [h].

The best time to chip a calf is with *the first handling* [acdhi] / *In the first few weeks of its life,/ when it's still hand manageable* [deg] or /*when transported* [bcfj]. The best place to mark/chip the rhino is the *(left) ear* [afgh], /*neck* [bj], / *left shoulder* [cei], / *base of ear or/ base of tail* [d].

2.6.2 General handling

It is advisable to train the rhinos for inspections and treatments [abcdefghij]. This should always be done with a barrier between keeper and animal. Holden *et al* (2006) found that operant-conditioning can be an important aspect of the daily husbandry routine. Through training, routine management and monitoring of rhinoceros can be carried out more effectively and with minimal stress and risk to animals and keepers when using operant-conditioning techniques. Numerous procedures can be carried out without the need for immobilization, and the trust between the animals and the keeper and veterinary staff will strengthen.

The programme can also be viewed as a form of stimulation for rhinoceros in captivity, improving physical and psychological well-being, and complementing other aspects of husbandry, such as environmental enrichment and habitat complexity. A list of commands and training tips of the International Rhino Keepers Association (IRKA 2010b) can be found in appendix III.

2.6.3 Catching/restraining

The doors of the pens and stable should be closed *hydraulic* [bcdfgj]/ *manual* [acdeghi] to prevent accidents. *Another necessary adaptation to the stable is a shute* [bcdefghij]/ *A shute is not necessary in the indoor housing* [a]. This way the rhinos can be easily guided into the transport box when needed. A squeeze cage *is needed* [bdefghij]/ *is not needed* [ac] in the stable for medical treatments and safety reasons.

The best way to minimize the stress during capture and restraint is to *tranquilize* [aj] / *train* [bcdefghj] the rhino. Training can be done by use of positive reinforcement [i]. A blindfold and ear muffs can be used to keep the white rhino calm [dj].

2.6.4 Transport

The IATA guidelines for transport apply when a white rhino is being transported. These guidelines give criteria for the crate and the care of the animal during transport. These guidelines can be found in appendix III. The IATA guidelines for transport should be followed when an animal is transported to another holding facility [abcdefghij]. For transportation, loading rhinos into a trailer has worked, but crating is preferred. First step will be to introduce the crate as a none-interactive part of the environment, which is followed by placing food stuff into the crate. For training the crate can be placed between the indoor and outdoor enclosure. This way the animal will get accustomed to passing through it. (Goltenboth *et al*., 2001) This way the animal will get used to being in the crate and it wouldn't stress him out when transported. The animal's overall condition should be closely monitored when transported on a trailer. Forced crating should not be practiced. (Goltenboth *et al*., 2001)

Container/ crate

During the transport the crate shown below (figure 18) or similar should be used [abcdefhij]. Larger crates are normally made of wood, reinforced by steel. (see figure 19) The crate's size should be designed in accordance to the animal's volume; it should always be larger in size than the animal by 1 m in width and length when laying on its sternum. Narrow bars in front help prevent eye and face injuries. To prevent damage of horns or facial injuries the bars should be angled away from the animal, sharp edges should be paid special attention to. (Goltenboth *et al*., 2001)

Figure 19. Rhino walking into crate

Crates should be used for long journeys [e]. As soon as the rhino is in the crate two bars should be pushed in the crate horizontally near the front/back of the crate. Also a small hatch to feed and inspect the animal. The Experienced Know-How in Professional Animal Transport (EKIPA) and Beekse Bergen have very good rhino crates [g]. In general an iron frame should be used in the whole crate, then the wood is a second barrier [i].

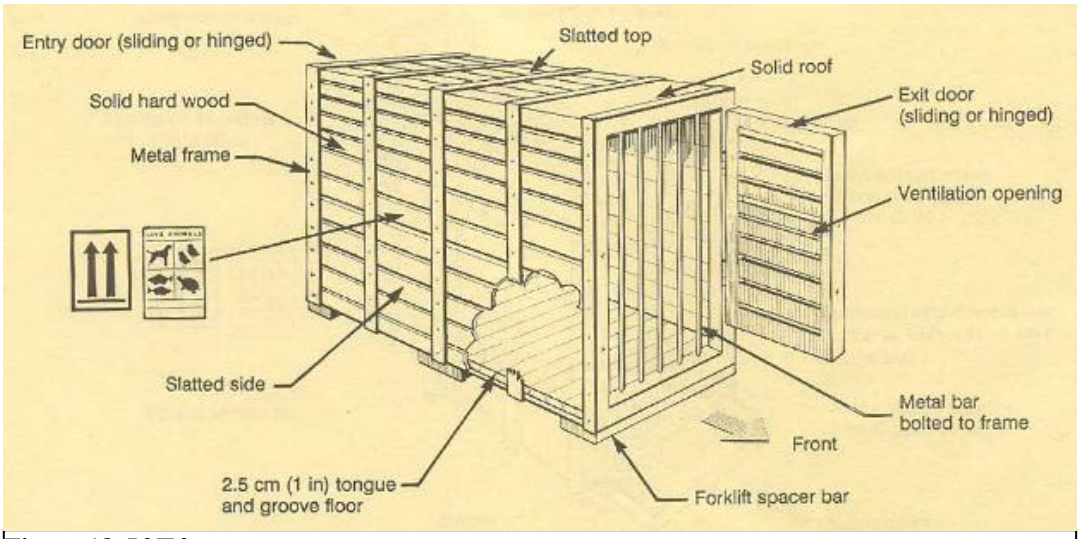

Figure 18. IATA crate

In preparation of the transport the animals *should* [afh] (Goltenboth *et al*., 2001) / *should not* [bcdegij] get a tranquilizer, *diazepam* [a], / *haldol* [g,] / *trilafon* [gi], *azaperone,* / *perphenazine* or/ *zuclopenthixol* [h]. Training will calm the animal [bc]. Tranquilizing can be dangerous since the animal could hurt itself. The best option to keep the white rhino as calm and stress free as possible is to do crate training from one month before the transport. (Goltenboth *et al*., 2001)

2.6.5 Safety

Metal edges, nuts, and screws must be secured with wood fittings to prevent injuries for the animals and staff. It is important to always consider fence spacing and keeper access respectively exit in case of emergency. Keepers should always fit through any two bars of the fence. (Goltenboth *et al*., 2001)

The following regulations should be kept in mind at all times when working with white rhinos: *No direct contact with the animals, only through poles* [acghi] / *always be alert and don't make sudden noises or movements that can startle the animal* [bcegh] / *Safety of operatives, reducing stress and preventing physical injury* [d]/ *Always look for escape passages* [fgh] / *Watch your feet* [j].

Due to training the white rhino, it can easily be examined with the least stress and highest safety levels for the keepers and vets (Goltenboth *et al*., 2001).

Escape

When a white rhino escapes the best way to go is to *evacuate the visitors out of the park* [dij] and then try to *lure the rhino to its enclosure with food* [iacde]. If this doesn't work, the animal can be *closed in with trucks to persuade it to go to its enclosure on its own* [dhij]. Another option is *to tranquilize the animal and then take it back to the enclosure* [dhi]. If all fails there should be a *powerful enough firearm at hand* [bj].

2.7 Veterinary

This section briefly outlines any physical conditions or complaints commonly associated with white rhinos. Symptoms, treatment and prevention of common diseases and conditions are outlined. Required vaccines are specified. Also common parasites, screening and treatments are outlined and information on causes of mortality is included. For all diseases and injuries applies that prevention is better than healing.

The behavioural repertoire of rhinos is often quite limited regarding illness. Depression and inappetence are often the only signs of major disease problems [abcdefghij] (Fouraker and Wagener, 1996). The most common diseases and injuries with white rhino in captivity are skin lesions [abcdefghij] / *tuberculosis* [gij] / *gastrointestinal torsion and impaction (colic)* [abhij], leiomyomas [c], magpies pecking into the dorsum of the animals [e], pleuritis, pneumonia, clostridium, fertility problems [g], internal tumors, pododermetitis [j]. Dental problems are not common in white rhinos [abcdefghj], but sometimes the molars have worn a wrong way [i]. In the table 16 (below) the inoculations are listed. White rhinos *should* [abcdefhij] / *should not* [g] be trained to ease inspection and treatment (see figure 20 and §2.6.2).

Figure 20. Keepers are inspecting a Southern white rhino

Table 16. White rhino inoculations with time interval

Type of inoculations	Time interval	Reference
Deworming	twice per year	h
Tetanus (depending on region)	once per year	ci
Vaccination against clostridium	once per year booster after 1 month	g
Johne's vaccine	when required	d
Tetanus for large open wounds		
-	never	abefj

2.7.1 Food problems

Nail cracks

"The most common problem seen in all rhino species is vertical cracking in the nail wall, which can range from mild quarter cracks to more extensive splitting up to the corona. Trauma to the bottom of the nail or the coronary band can generate cracks, and concrete flooring aggravates this by wearing and thinning the nail walls of the lateral toes while the rhino is lying down. Straw can make the hard concrete floor feel softer. Hooves have a natural waterproof, external layer called the periople which provides a protective coating and regulates evaporation or absorption. The periople can be damaged by concrete, sandy soils, chemicals, or improper filing. Dry, brittle nails lose resiliency and are more prone to splitting. Excess moisture can also cause damage. This moisture balance is influenced by the external

environment or affected by an inappropriate diet. Less prevalent are horizontal cracks in the nail which may occur after a serious illness, laminitis, or nutritional disorder." (Jacobsen, 2002)

"Treatment for cracked nails starts with cleaning the foot and carefully removing mud, grit, or faeces. This allows for closer inspection and keeps debris from wedging and opening the crack further. Topical antiseptics may be prescribed to prevent infection. Commercial hoof dressings should only be used with veterinary approval since some of these products contain turpentine or petroleum compounds, and the splitting nails may not be caused by dryness. Corrective trimming by experienced personnel could be used to relieve pressure on the bottom of the nail and enable the crack to grow out. However, by making changes in environment and husbandry most of these cracks can be allowed to grow out without intervention." (Jacobsen, 2002)

Laminitis

"Also referred to as founder, laminitis is a metabolic and vascular disease which can affect rhinos and other hoofstock. The disease begins when the blood supply to the corium (the sensitive laminae of the foot) is interrupted. Damage to the coronary corium causes band: of irregular horn growth called laminitic rings. In severe cases the union between the horny and sensitive laminae breaks down and progresses to separation of the nail at the coronary band. Some common causes of this disease are excessive feeding of concentrates, enteritis, chronic renal failure, and IHVS." (Jacobsen, 2002)

"The first signs of laminitis are lameness and inflammation or discharge at the coronary band. Gradually a gap appears at the top of the nail. It is possible for the affected nail to remain while the new nail grows and displaces it. With total separation the nail is only attached at the sole and tends to fold under the foot as the rhino walks. In this case, the nail is removed under anaesthesia. Post-op treatments include good hygiene, keeping the foot and exposed laminae clean, topical antiseptics and pain management. New nail growth is usually completed in six months." (Jacobsen, 2002)

2.7.2 Parasites

"Parasites only play a major role in newly captured animals and in animals kept on grass land in tropical climatic zones. With the modern broad range anthelmintics for horses also rhinos can be treated (according to body weight) successfully and without problem. If an animal is newly arrived from an area of tropical climate screening should include blood exams for haemic parasites, trypanosomes, theileriasis and leishmaniasis." (Goltenboth *et al.*, 2001) In table 17 (Goltenboth *et al.*, 2001) descriptions and treatments are given for parasites.

Table 17. Parasites, description and treatment in white rhinos

Parasites	Description	Treatment
Protozoa	Trypanosoma, Babesia, Theileria) are wide-spread in rhinos in Africa but are of no relevancy in zoos.	Treatment has been tried with DIMINAZENACETURAT (BerenilR,Hoechst) at a dose of 2-5 mg/kg BW.
Gastro-intestinal parasites	Coccidiosis, Balantidium coli and Trichomoniasis) occasionally cause diarrhea especially in young rhinoceroses.	Successful treatment has been executed with AMPROLIUM (AmprolvetR, MSD-Agvet) respectively Jodochlor hydro-xyquin.

Parasites	Description	Treatment
Cestodes	Rhinos, newly arrived from the wild, for years may show in the faeces proglottides from Anoplocephala sp. and A. gigantea. Animals weakened by other illnesses frequently show massive infestation.	Recently successful treatment has been executed with PRAZIQUANTEL at a dose of 0,5 - 1 mg/kg BW.
Nematodes	A large number of gastro-intestinal nematodes has been seen, such as Strongyloides sp., Kiluluma sp., Quilonia sp., Drascheia sp., Probstmayria sp., Oxyuris karamoja, Habronema khalili, Parabronoma rhinocerotis, Grammocephalus intermedius and Gr. clathrotus.	The application of modern broad range anthelmintics such as THIABENDAZOLE, FENBENDAZOLE, MEBENDAZOLE, PYRANTHEL TARTRATE and IVERMECTIN keeps parasites well under control (doses to be based on those for horses).
Arthropodes	White rhinos are often carrier of larvae of the warble-fly Gyrostigma pavesii. Also, Gastrophilus-larvae are frequently found in rhinos newly arrived from the wild. The larvae cling to the gastric wall and are excreted with the faeces. Severe infestation can cause inflammations. In imported rhinos for some time flies may still hatch from larvae when kept in well heated enclosures.	Treatment with IVERMECTIN per os will eliminate the larvae.

Parasites have been of low frequency and are usually not associated with clinical signs in captive white rhinos [abcdefghij] (Fouraker and Wagener, 1996). The parasites that are found are listed in table 18.

Table 18. Parasites found on white rhinos in captivity, screening interval and reference

Type of parasite	Parasite	Reference
Ecto-parasites	ticks	[cfhj]
	mites	[d]
	flies	[e]
	Ear mites, fly strike i.e. maggots around the horn base	[b]
	non	[abgi]

Type of parasite	Parasite	Reference
Endo-parasites	tapeworms	ahj
	stomach botfly larvae	fhj
	nematodes	eg
	non	bcdi
Screening for parasites	four times per year	d (more frequently for calves) g
	three times per year	e
	twice per year	a g (deworming) hj
	once per year	bcfi

2.7.3 Bacterial infections

Pressure sores and ulcers are common especially in older animals [j]. This opens doors for bacterial infections. "Multi-bacterial infections can be hazardous to all rhino species. They are caused mainly by traumatic injuries, affection of the lungs and the gastro-intestinal tract and often lead to general septicemia that prove fatal. Successful treatment is dependent upon the possibility to apply high doses of the appropriate antibiotics. It must be stressed that tuberculosis is dangerous to all rhino species. Like in other zoo animals, intracutanous tuberculinization is best set on the upper eyelid. Set behind the ear or on the tail, it is of little evidence und must be done in support of an ELISA-test or the direct demonstration of the infectious agent. Treatment is very rarely indicated and seldom shows satisfactory results. Salmonella-infections can successfully be treated with endrofloxazin (BaytrilR, Bayer)." (Goltenboth *et al.*, 2001)

2.7.4 Viral diseases

"With an outbreak of elephant-pox in captive elephant herds also black and white rhinos become infected, in cases showing acute systemic disturbances. Vaccination against elephant-pox is recommended with the Modified Vaccinia-Virus Ankara (MVA). In cases of ulcerative dermatitides and pox-like skin diseases the presence of a Herpesvirus-infection should always be taken into consideration." (Goltenboth *et al.*, 2001)

2.7.5 Mortality

The most common causes of mortality in captivity for adults are old age [abcdefghij], / *fighting* [cfgh], / *diseases* [dgj] and *accidents* [c]. In juveniles *fighting* [cfgh] / *diseases* [adfhij] /*birth problems* [c] / *accidents* [c] are the most common causes of captive mortality. *To be absolutely sure about the cause of mortality, a post mortem investigation should* [bcdefhij] *be done on every deceased white rhino. / A post mortem investigation is not always necessary* [ag]. *Therefore an institution holding white rhinos should* [abcdehij] *have a post mortem protocol.* / *It is not necessary to have a white rhino post mortem protocol* [fg].

2.7.6 Diet

Nordstrom and Bissonette (2006) found that "the frequency of health problems was mainly determined by diet, with the most problems occurring when pelleted feed was more than 40% of the total diet. Zoos that provided produce as a part of their diet also experienced more health problems among their white rhinos. Skin problems, although a rare occurrence, were the most frequently reported health problem. They found that increased percent produce in the diet and amount of time spent with the animals by keepers were related to skin problems.

Climate also may play a role in the frequency of health problems, with more health problems recorded in zoos in warm, dry climates but less skin problems in warm, wet climates." Other dietary problems are listed in table 19 (Clauss and Hatt, 2006).

Table 19. Diet based health problems

Health problem	Recommendation
Farmer's lung condition	"Hay should account for the major proportion of any diet for rhinoceros in captivity. The importance of the hygienic quality of the hay has been emphasized by cases resembling a 'farmer's lung condition"
Hypophosphataemia	"Roughage based diets are particularly vulnerable to phosphorous deficiency. Hypophosphataemia (low levels of phosphorus in the blood) has been observed in rhinoceros with haemolytic crises, so a deficiency of this mineral in the diet should be avoided."
Colic	Avoid ingestion of sand, which can cause colic.
Skin and foot lesions	"Zinc deficiency may lead to the development of skin and foot lesions"
Skin and eye diseases and disturbances of the digestive system	Vitamin A deficiency, high doses of vitamin A should be applied intramuscular. (Goltenboth *et al.*, 2001)

2.7.7 Anesthetics

"Due to the size and behaviour, anaesthetic management of white rhinoceroses is challenging and adequate planning is necessary to minimize risk. Injectable anaesthetic techniques are more frequently used than inhalant anaesthesia since most procedures are short and performed under field conditions. However for longer recumbency times or more invasive surgical procedures the use of inhalant anaesthesia is preferred." (Valverde *et al*., 2010) See §2.6.3 for the right enclosure design for optimal use when catching or restraining a white rhino.

2.8 Specific problems

As said before, numbers of white rhinos in the wild are increasing, but the European population in captivity is not self-sustainable. This is partly because of the second generation reproductive problem [d]. Also introductions are a vital part of a successful breeding program. Therefore the discussion about a 'gentle' male in case of introduction and enough space for separation [g] should be re-opened.

The female white rhinoceros lives in herds of approximately six animals. The males live solitary and they meet only to breed. This is hard to realize in captivity because of the big enclosure size needed. It should be prevented that white rhinos are held isolated or kept in small exhibits [i].

The existence of these problems shows that not all is known about keeping white rhinos. This is why more research needs to be done. The husbandry guidelines need to be updated regularly. These concept husbandry guidelines are one step forward to an uniform best-practice policy in EAZA institutions.

2.9 Recommended research

The experts have recommended additional research on the following subjects:

- Introduction techniques for calves to males [b]
- Follow up studies of the work Volker Grün did in New Zealand [c]
- The poor reproductive rates of most of our collections [d]
- More research on Tb testing [d]
- Sex of offspring relative to quality of food [e]
- (female) group composition correlated to reproduction is of primary importance in my view [f]
- Real social structure which is needed for breeding [h]
- Hormonal deprivation of young females [i]
- Captive breeding research is critical to enable captive populations to become self-sustaining [j]
- Further research into copper metabolism in white rhinos is needed. (Clauss and Hatt, 2006)

Discussion

EAZA is developing husbandry guidelines for higher welfare in member institutions, aiming for better reproduction success and easier exchange of animals between EAZA institutions because of uniform conditions. Proper animal husbandry is needed for good population management and helps conservation of the white rhinoceros. (EAZA, 2009b)

The aim of this research was to produce concept husbandry guidelines for the white rhinoceros by gathering the available data, to give information on the white rhino in the wild and in captivity. This was done by a study of scientific literature and interviewing ten international white rhino experts, selected by the EEP co-ordinator. Especially the EAZA draft African Rhinoceroses Husbandry Guidelines for Rhinoceroses (Goltenboth *et al.*, 2001) and the selected experts together with parts of the AZA Rhinoceros Husbandry Resource Manual (Fouraker and Wagener, 1996) are used as main sources during the construction of this document. The concept husbandry guidelines for the white rhinoceros is its result and gives an overview of the biology, field data and management in captivity. It contains the basic information on the best practice how to keep white rhinos in captivity and needs to be adapted into final husbandry guidelines by the EEP committee. All subjects of the EAZA husbandry guidelines format (Appendix I) are covered in these concept husbandry guidelines. More research is conducted, so the husbandry guidelines need to be updated regularly.

The white rhino experts agreed on most husbandry subjects, but opinions on some topics, like social structure and especially breeding, differed greatly. This raises a problem for captive reproduction. Since this document is a 'concept' husbandry guidelines, it is decided to compile the available information and leave the decision, which information is used, up to the final editors.

A white rhino in the wild is consuming large amounts of short grasses (Steuer *et al.*, 2010). The captive situation is in great contrast with the natural feeding ecology. Zoos are feeding in addition to grass and hay also fruit, vegetables and even processed food like bread and flaked maize.

To see if the current situation has huge differences as in the wild, both situations are compared. In the wild female groups up to six animals are commonly seen and males live basically solitary and associate only with females in oestrus (Tomasova, 2006). In captivity it is only recently advised to hold 2.3 white rhinos. This has implications on enclosure size and design when wanting to mimic the wild situation.

A comparison is made with different husbandry guidelines of other species.

The leopard husbandry guidelines (Houssaye and Budd, 2009) is a final version, and it contains more scientific resources than these concept husbandry guidelines. It is made by using a different format and is about the different leopard species with a general description of the leopard husbandry needs.

The husbandry guidelines for the hyenas (Schelvis and Spijkman, 2008) contain the same type and amount of information as this concept husbandry guidelines. They used approximately the same number of experts (eleven) and literature for information.

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Title page	Picture taken by Paula Anguita - Geerts on 24th November 2009 Available from: http://tilburgers.nl/?p=4985 (accessed: 9th April 2010)
Fig. 1	Boomsma, W. T., and Sijde, van der, M.D. (2010)
Fig. 2	Available from: http://www.desertusa.com/animals/images/white_rhino.jpg (accessed: 30th September 2010)
Fig. 3	Frank Leslie, *The Kingdom of Nature, an Illustrated Museum of the Animal World* (Chicage: Thompson & Thomas, 1900) 182 Clipart ETC is copyright © 2010 by the University of South Florida. Available from: http://etc.usf.edu/clipart/23700/23772/rhino_skelet_23772.htm (accessed: 30th September 2010)
Fig. 4	Emslie, R. and Brooks, M.1999, *African Rhino Status Survey and Conservation Action Plan*, IUCN/SSC African Rhino Specialist group. IUCN , Gland, Switzerland and Cambridge, UK.
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Fig. 19 Available from: http://img2.photographersdirect.com/img/12366/wm/pd304308.jpg (accessed: 7th October 2010)
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Appendices

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Appendix II: EAZA minimum standards for the accommodation and care of animals in zoos and aquaria

2008 European Association of Zoos and Aquaria
Update of the EAZA Standards for Accommodation and Care of Wild Animals in Zoos (1994) and the Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria (2006)
- Approved by EAZA Council on 19 September 2008 -

Introduction

These standards are based on present knowledge and practice for the accommodation and care of animals in zoos and aquaria.

In this Annex the following definitions shall apply:

1. **Zoos and aquaria** shall refer to all establishments open to and administered for the public to promote nature conservation and to provide education, information and recreation through the presentation and conservation of wildlife. This definition shall include zoos, animal parks, safari parks, bird gardens, dolphinaria, aquaria and specialist collections such as butterfly houses as defined in article 2 of Council Directive 1999/22/EC of 29 March 1999. Zoos and aquaria situated in EU countries are requested to have a valid license under Council Directive 1999/22/EC of 29 March 1999. All others need valid licenses to operate, if these exist. The dates and/or numbers of these licenses have to be registered with the EAZA Executive Office;

2. **Animals** shall refer to all species of the animal kingdom including species of the classes Mammalia, Aves, Reptilia, Amphibia, Pisces, groups of Invertebrata;

3. **Welfare** shall refer to the physical, behavioral and social well-being of animals through the provision of appropriate conditions for the species involved, including but not necessarily limited to housing, environment, diet, medical care and social contact where applicable;

4. **Enclosure** means any accommodation provided for animals in zoos and aquaria;

5. **Enclosure barrier** means a barrier to contain an animal within an enclosure;

6. **Stand-off barrier** means a physical barrier set back from the outer edge of an enclosure barrier designed to prevent public access to the latter;

7. **Hazardous animals** means any representative of the groups or species listed in Annex 1 and any other animal which, because of its individual disposition, sexual cycle, maternal instincts, or for any other reason, whether by biting, scratching, butting, compression, injecting venom or by any other method, is likely to injure seriously or transmit disease to humans;

8. **Dangerous carnivores** means all members of the genera Panthera, Acinonyx, Lynx and Neofelis, the families Ursidae and Hyaenidae, Canis lupus, Canis rufus and Lycaon pictus.

The Standards

ANIMAL CARE - WELFARE, HEALTH AND HYGIENE

Routine observation of the animals

1. The condition and health of all animals in the zoo to be checked daily by the persons in charge of their care for that particular day.

2. Any animals which are noted to be unduly stressed, sick or injured to receive immediate attention and, where necessary, treatment.

Accommodation - Space, Exercise and Grouping

3. Animals to be provided with an environment, space and furniture sufficient to allow such exercise as is needed for the welfare of the particular species.

4. Enclosures to be of sufficient size and animals to be so managed:
   a. to avoid animals within herds or groups being unduly dominated by individuals;
   b. to avoid the risk of persistent and unresolved conflict between herd or group members or between different species in mixed exhibits;
   c. to ensure that the physical carrying capacity of the enclosure is not overburdened;
   d. to prevent an unacceptable build-up of parasites and other pathogens.

5. Animals not to be unnaturally provoked for the benefit of the viewing public.

6. Animals in visibly adjoining enclosures to be those which do not interact in an excessively stressful way.

7. Separate accommodation for pregnant animals and animals with young to be available, if necessary, in the interests of avoiding unnecessary stress or suffering.

8. Provide appropriate accommodation for animals being temporarily separated from a group.

Accommodation - Comfort and Well-being

9. The temperature, humidity, ventilation and lighting of enclosures to be suitable for the comfort and well-being of the particular species of animal at all times, and in particular:
    a. consideration to be given to the special needs of pregnant and newly-born animals;
    b. newly-arrived imported animals to be fully acclimatized bearing in mind that this may be only a gradual process;
    c. tanks for fish and aquatic invertebrates to be adequately oxygenated, and appropriate water quality to be provided.

10. Animals in outdoor enclosures to be provided with sufficient shelter from inclement weather or excessive sunlight where this is necessary for their comfort and well-being.

Furnishings within Enclosures

11. Animal enclosures to be furnished, in accordance with the needs of the species in question, with such items as bedding material, perching, vegetation, burrows, nesting boxes and pools.

12. Provide appropriate environmental and behavioural enrichment.

Prevention of Stress or Harm to Animals

13. Enclosures and barriers to enclosures to be maintained in a condition which presents no likelihood of harm to animals, and in particular:
    a. any defect noted in an animal barrier or in any appliances or equipment within animal enclosures to be repaired or replaced without delay;
    b. any defect likely to cause harm to animals to be rectified at once or, if this is not possible, the animals to be removed from the possibility of any contact with the source of the danger;
    c. any vegetation capable of harming animals to be kept out of reach.

14. All plants and fixed equipment, including electrical apparatus, to be installed in such a way that it does not present a hazard to animals and its safe operation cannot be disrupted by them.

15. Rubbish in animal enclosures to be cleared regularly to avoid any possibility of harm to animals.

16. Trees within or near animal enclosures to be regularly inspected and lopped or felled as appropriate to reduce the risk of animals being harmed by falling branches or using trees as a means to escape.

17. Smoking is prohibited in animal enclosures, in parts of buildings where animals enclosures are located and in areas where food is stored or prepared.

18. Animals to be handled only by, or under the supervision of, competent trained authorized staff; and this to be done with care, in a way which will avoid unnecessary discomfort, behavioural stress or actual physical harm to animals.

19. Any direct physical contact between animals and the visiting public only to be under the control of zoo staff and for periods of time and under conditions consistent with the animals welfare and not leading to their discomfort.

Food and Drink

20. Food and drink provided for animals to be of the nutritive value and quantity required for the particular species and for individual animals within each species, bearing in mind the condition, size and age of each animal; the need to allow for special circumstances (e.g. fast days or longer periods of fast or hibernation) and special diets for certain animals (e.g. animals undergoing a course of veterinary treatment, or pregnant animals).

21. Veterinary or other specialist advice to be obtained and followed concerning all aspects of nutrition.

22. Supplies of food and drink to be stored, prepared and offered to the animals under hygienic conditions.

23. Natural behaviour of the animals, particularly social aspects to be considered when offering food and drink, and feeding and drinking receptacles if used, to be placed so as to be accessible to every animal kept within a particular enclosure.

24. Uncontrolled feeding by visitors is not permitted. Where feeding is permitted it should be on a selective basis only with suitable food provided and approved by the management.

Sanitation and control of disease

25. Proper standards of hygiene, both in respect of the personal hygiene of the staff and that of the animal enclosures and treatment rooms, to be maintained, and in particular:
    a. special attention to be given to the cleaning of animal enclosures and equipment within them, to reduce the risk of disease or disease transfer, including in the case of aquatic animals, regular monitoring of water quality;
    b. non-toxic cleaning agents to be readily available, along with supplies of water and the means to apply them;
    c. veterinary advice to be obtained and followed regarding all cleaning and sanitation requirements of enclosures or other areas following identification of an infectious disease in any animal.

26. The drainage of all enclosures to be capable of removing efficiently all excess water.

27. Any open drains, other than those carrying potable water, to be outside the areas to which animals have access.

28. Refuse material to be regularly removed and disposed of.

29. A safe and effective programme for the control of pests and, where necessary, predators to be established and maintained throughout the institution. It is also requested that animals must not escape from the zoo or aquarium, and create an ecological threat for native wild species.

30. Keeper staff to be instructed to report immediately if they have contracted or are in contact with any infection which they have reason to believe could be transmitted to, and aversely affect the health of, any animal; and management then to take appropriate action.

31. Keeper staff to be instructed to report in confidence any other disability which might affect their capacity to manage the animals in a safe and competent manner; and management then to take appropriate action.

ANIMAL CARE - VETERINARY ASPECTS

32. Arrangements to be made for routine veterinary attendance. In case of fishes and invertebrates, other specialist attendance is also acceptable. This also applies to all other references to veterinary aspects in fishes and invertebrates in this document.

33. A programme of veterinary care to be established and maintained under the supervision of a veterinary surgeon or practitioner.

34. Routine examinations, including parasite checks, to be carried out and preventive medicine, including vaccination, to be administered at such intervals as may be recommended by a veterinary surgeon or practitioner.

35. Where a full veterinary service is located at the institution, the facilities to include: an examination table; a range of basic surgical instruments; anesthetic facilities; basic diagnostic instruments; sufficient power points to take light and other electrical fittings; facilities, where appropriate, to take blood and other samples and to prepare and dispatch them; and a comprehensive range of drugs.

36. Where a full veterinary service is not available at the institution, a treatment room to be provided at the premises for use where appropriate for the undertaking of routine examination of animals in clean, ventilated surroundings.

37. A room or rooms to be provided for the care of unduly distressed, sick and injured animals and facilities for hand-rearing and nursing animals.

38. Facilities to be available for collecting, restraining and, if necessary, for administering a general anesthetic, for euthanizing animals and for the aftercare of animals recovering from sedation.

39. Reserve accommodation to be available, away from other animals, for the isolation and examination of newly-arrived animals, under quarantine restrictions (conditions) where necessary.

40. Newly-arrived animals to be kept isolated as long as is necessary to ensure proper examination before introduction to other animals in the collection.

41. Particular attention to be paid to hygiene in the quarters where isolated or quarantined animals are kept.

42. Where practicable, protective clothing and utensils used by staff in the isolation area should be used, cleaned and stored only in that area.

43. All animal drugs, vaccines and other restricted veterinary products to be kept safely under lock and key with access by authorized persons only.

44. Except under the direction of a veterinary surgeon or practitioner, members of the staff of the zoo not to possess or administer controlled drugs.

45. Zoo management to seek agreement with the consulting local veterinary adviser regarding the desirability of either the zoo or aquarium, a local hospital or the veterinary surgeon or practitioner himself, of holding supplies of antidotes to potentially toxic veterinary products used at the institution.

46. All unwanted, contaminated veterinary equipment to be disposed of safely and following relevant legislative prescriptions.

POST-MORTEM FACILITIES

47. Dead animals to be handled in a way which avoids the risk of any transmission of infection.

48. The cause of death for each animal dying in the collection to be established where reasonable and practicable to do so, including, in the majority of cases, the examination of carcasses by a veterinary surgeon or a practitioner or a pathologist with relevant experience and training.

49. Where animal carcasses cannot be quickly removed to a professional veterinary laboratory centre outside the premises, facilities should be provided for conducting post-mortem examinations and the processing of samples resulting from them in a safe and hygienic manner. If immediate post-mortem examination is not possible, then in consultation with the veterinary surgeon or practitioner, refrigerated facilities or a deep freeze for storage to be provided pending the removal in a suitable insulated container to a post-mortem laboratory.

50. Facilities and equipment in any room provided on the premises for post-mortem examinations to include: an efficient drainage system; washable floors and walls; an examination table; an adequate selection of appropriate instruments; facilities for taking and preserving specimens; and, if larger animals are kept in the collection, a hoist.

51. Following post-mortem examinations conducted on the zoo premises, carcasses and organs to be removed swiftly and disposed of safely.

SAFETY AND SECURITY

General provisions

52. Local safety and security legislation regarding zoos and aquaria must be applied.

Enclosures

53. Other than when elsewhere in the control of authorized staff, animals kept for exhibition in the zoo to be kept at all times in enclosures or, in the case of free-running non-hazardous animals, within the perimeter of the zoo.

Enclosure barriers

54. Enclosure barriers to be designed constructed and maintained to contain animals within the desired enclosures.

Stand-off Barriers

55. Where direct contact would be possible between visitors and hazardous animals through or over any enclosure barrier, to the extent that such an animal would be capable of causing injury, a stand-off barrier to be provided sufficiently far back to prevent such contact.

Perimeter Boundaries

56. The perimeter boundary, including access points, to be designed, constructed and maintained to discourage unauthorized entry and, so far as is reasonably practicable, as an aid to the confinement of all the animals within the perimeter of the institution.

57. No perimeter barrier to include any electrical section less than 2 meters from the ground, except in those cases where it also serves as a normal animal barrier and cannot be reached by the visiting public.

Warning Signs

58. In addition to a stand-off barrier, an adequate number of clearly visible safety signs to be displayed at each enclosure where there may be significant danger, including electric fences.

Exits

59. Sufficient exits from the zoo or aquarium to be provided, having regard to the size of the institution and the number of visitors anticipated at any time who may need to leave quickly in an emergency.

60. Exits to be clearly signposted and marked.

61. Each exit from the zoo or aquarium to be kept clear and to be capable of being easily opened from inside to allow the release of persons from the institution. All such gates to be capable of being closed and secured to discourage the escape of animals.

Drive-Through Enclosures

62. Unless there is stricter local legislation, this chapter will be applied to drive through enclosures.

63. Where dangerous carnivores are kept in drive-through enclosures, entry and exit to such enclosures to be through a system of double gates, with sufficient space between to allow the gates to be securely closed to the front and rear of any vehicle which may enter or need to enter the enclosures.

64. In the case of dangerous carnivores the access gates to be protected by fencing positioned at right angles to the perimeter fence on each side of the roadway with the enclosure, and of the same standard as that for the main enclosure barrier and extending back from the access for a distance of at least 25 meters.

65. Double gates to be designed and maintained so that, where hazardous animals are within or have access to the enclosure secured by the gates, one gate cannot be opened until the other has securely closed - though, provided no danger to the public is thereby caused, provision may be made for this arrangement to be overridden in the event of an emergency arising.

66. For other hazardous animals, except those grazing or hoofed animals where a cattle grid would be sufficient to contain them, single entry/exit gates, supervised at all times, to be provided.

67. Access points between enclosures to be controlled to prevent animals entering adjoining enclosures.

68. Electrified pressure pads, where used, to be designed and installed to ensure that in the event of their failure, any gate they control will close automatically or otherwise operate to ensure that animals are safely secured within their enclosure.

69. Gates which are mechanically-operated to have an alternative method of control whereby they can be opened and closed manually in the event of an interruption of the power supply or other emergency and to be designed to close automatically when subject to power failure.

70. Operators of mechanically-operated gates to have a clear, unobstructed view of the gates under their control and of the area within the vicinity of those gates.

71. A one-way road system to be used to assist the traffic flow and thus reduce the risk of accidents.

72. Stopping to be permitted only at places where the road is at least 6 meters wide.

73. Where dangerous carnivores and primates and (except where the enclosure is supervised by competent staff in a manner which prevents any danger to the public) any other hazardous wild animal are kept:
    a. no vehicle to be allowed access unless a rescue vehicle capable of effecting its recovery is immediately available;
    b. access to vehicles without a solid roof to be prohibited at all times;
    c. notices, which are readily visible and easy to read, to be displayed to warn visitors whilst in the enclosure to:
    I. Stay in vehicle at all times;
    II. Keep all vehicle doors locked;
    III. Keep vehicle windows and sun-roof closed;
    IV. Sound the horn or flash the headlights and await the arrival of a rescue vehicle if they break down.

74. Continuous observation to be maintained over the entire area of each enclosure containing any hazardous animal.

75. The staff member in overall control of supervision to be armed with an appropriate firearm and to be trained in its use so that a hazardous animal can be killed in an emergency if this will save human life or injury.

Removal of animals from enclosures

76. Hazardous animals not to be allowed out of their usual enclosures for the purpose of direct contact with the public, except, where the zoo operator is satisfied that such animals are not, when under control, likely to cause injury or transmit disease.

77. Where hazardous animals are allowed out of their usual enclosures an authorized and experienced member of the staff to accompany each animal. 78. Zoo operators to exercise caution and discretion in the case of the removal of non-hazardous animals since the behaviour of all animals may be less predictable when away from their usual enclosures.

79. Precautions to be taken to avoid injury to visitors when animals are used for rides.

Escape of animals from their enclosures

80. Zoo operators to assess whether any danger may arise in the event of an animal escaping from its enclosure and to consider the possible or likely attempted escape route within and from the institution if this were to happen.

81. In the case of the escape of animals emergency plans must be available and fully understood and practiced by all staff.

82. This emergency plan should include a member of staff to be readily available at all times to take decisions regarding escaped animals, including the use of firearms if needed.

83. Every employee with tasks under the emergency procedures to undergo periodic refresher training and practice.

Safety of access for the public

84. Buildings, structures and areas to which the public has access to be maintained in safe condition.

85. Trees within areas where visitors are likely to be walking or sitting to be regularly inspected and lopped or felled as appropriate to avoid visitors being harmed by falling branches etc.

86. Warning to be given of all edges where a person might fall, including into water; and, where necessary, such edges to be guarded by a barrier which would be capable of restraining children from falling.

87. Each walkway over an animal enclosure to be designed, constructed and maintained to withstand safely the weight of the maximum of adults who could use it at any time; and maintained, sited or protected so as to withstand any contact by hazardous animals and prevent contact between such animals and visitors.

88. The visiting public not to be allowed to enter any buildings or other areas of the zoo premises which could present an unreasonable risk to their health and safety.

89. Any buildings to which visitors are not allowed on the grounds referred to above, to be kept locked and warning notices to be displayed to indicate that access is both unsafe for, and not permitted to, the public.

90. Other areas to be clearly defined, e.g. by means of barriers and similar warning notices, or by suitable notices together with road markings where frequent access is necessary for vehicles operated by zoo staff along roadways to which the public are not admitted.

Emergency First-Aid

91. First-aid equipment and written first-aid instructions to be readily accessible on the premises.

92. Where venomous animals are kept, the appropriate and up-to-date anti-venom to be held at the zoo or a local hospital or within a reasonable time frame ensuring the safety of staff and visitors, and kept in accordance with the manufacturer's instructions.

93. Written instructions to be provided for staff on the procedure to be followed in the event of an incident involving any venomous animal and a visitor or another staff member. These instructions to include:
    a. immediate action to be taken in respect of the patient and;
    b. required information on a pre-prepared form for forwarding to the local hospital which would include:
    I. the nature of the bite or sting and the species inflicting it;
    II. the specification, for cross-reference purposes, of the anti-venom which accompanies the patient;
    III. the telephone number of the nearest poisons centre;
    IV. the telephone number of the institution.

MISCELLANEOUS

Insurance against liability for damage or injury caused by animals

94. Zoo operators to hold a current liability insurance policy or other legal arrangements which indemnifies them and every other person under a contract of service or acting on their behalf, against liability for any damage or injury which may be caused by any of the animals, whether inside or outside the zoo, including movement by vehicle. Any upper limit on the sum involved which is included in the terms of such insurance to be set at an adequate and realistic level.

Stock records

95. Records to be kept by means of an established and globally recognized and accepted record system and maintained in relation to all individually recognized animals and groups of animals.

96. Where animals are disposed of or die, the records to be kept in the appropriate recording system as described in Article 95.

97. The records to be kept on a computer system using the ARKS software, or Zoological Information Management System when available, and to be included on the global zoo animal database of ISIS, by means of which information can be quickly retrieved.

98. The records should provide the following information:
    a. the correct identification and scientific name;
    b. the origin (i.e. whether wild or captive born, including identification of parents, where known, and previous location/s, if any);
    c. the dates of entry into, and disposal from, the collection and to whom;
    d. the date, or estimated date, of birth;
    e. the sex of the animals (where known);
    f. any distinctive markings, including tattoo or freeze brands etc.;
    g. clinical data, including details of and dates when drugs, injections, and any other forms of treatment were given, and details of the health of the animal;
    h. the date of death and the result of any post-mortem examination;
    i. the reason, where an escape has taken place, or damage or injury has been caused to, or by, an animal to persons or property, for such escape, damage or injury and a summary of remedial measures taken to prevent recurrence of such incidents.

99. In addition to the individual records, an annual stock list of all animals to be kept preferably in the form given below. (Estimated numbers should be available for all fish and invertebrate species).
    1. Common and scientific names of the species
    2. Total in the collection at 1 January
    3. Number of arrivals into the collection from all sources during the year
    4. Number of births into the collection during the year
    5. Number which died within 30 days of birth
    6. Number which died older than 30 days after birth/hatching

7. Number departed collection, including sales, breeding loans, etc.
8. Total remaining in the collection at 31 December

This record, giving details of male/female/unsexed animals as appropriate, to be set out in columns for ease of compilation and reference, e.g.: All records can be kept in the local language or in the English language (in order to facilitate the international exchange of information and cooperation).

Common name	Scientific name	Group 1-1-05	Arrive	Born	Neonatal death	Death	Depart	Group 31-12-05
Bennett's wallaby	Macropus rufogriseus	5.11.0	1.0	1.1.8	1.0.3	1.2.0	1.1	4.9.5

100. Surplus animal stock only to be passed on to responsible persons who have the appropriate facilities and expertise (cf also EAZA Code of Ethics).

Transportation and Movement of Live Animals

101. Facilities suitable for hoisting, crating and transportation of all the kinds of animals kept within the zoo, to destinations both inside and outside the zoo, to be available if not kept at the zoo.

102. Any animal taken outside the zoo to be in the personal possession of the operator of the zoo, or of competent persons acting on his behalf, and adequate provision to be made for its safety and well-being at all times.

103. Any hazardous animal taken outside the zoo to be kept securely at all times. Such animal to be kept away from direct contact with persons other than the zoo operator or competent persons acting on his behalf, except where the zoo operator is satisfied that it is not likely, when under control, to cause injury or transmit disease.

Appendix III: Rhinos and training

To improve rhino management, keepers have developed training guidelines to meet a variety of husbandry needs and provide mental stimulation. A well-managed program would enhance the success of most non-invasive veterinary procedures, as well as permit the execution of more intensive practices. In general, the same training principles can be applied to all rhino species, but it is imperative that the keepers are consistent and follows the institution's training protocols.

Description of Selective Behaviours and Their Commands

Target - This command is used for positioning of the rhino. The correct response is to touch the target with its upper lip. The target is placed at the location where the trainer wants the rhino positioned and when the rhino approaches the target it will touch the target with its upper lip.

Lean In or Over - This command is used for lateral positioning the rhinos for blood draws, and can be used to evaluate the condition of the rhino. To get the animal to perform this behaviour the trainer uses the command "target" to line the animal up, and then holds the target to the animal's hip or shoulder. When the "over" command is given, the animal should then side step towards the target. The correct response to this command is to bring the targeted side of the rhino towards the barrier (being lined up parallel with the barrier), with the hip or front shoulder actually touching the target. The animal can be stopped at any point by using the bridge, but is generally asked to step all the way to the barrier so the animal's side is in contact with it.

Back side Front Shoulder

Open - This command is used for checking the mouth for gum coloration, presence of lesions or sores, or general dentition inspection. With this command, the trainer targets the animal's head into proper position, and then issues the command "open". The correct response for this

command is to have the mouth open far enough to check the animal's teeth. Some trainers actually use the physical cue to touching the upper and/or lower lip(s) as the signal with the "open" command. Then use the "hold" command to maintain the mouth in desired position.

Foot - This command can be used for positioning desired leg for phlebotomy procedure and can be used to perform any necessary footwork. Place the block in front of the desired foot (usually the foot closest to trainer), and give the command "foot" to signal lifting of foot onto the block and placing it flat on the surface. Once the foot is on the block, the trainer then places a hand on top of the foot while saying, "steady". The rhino should keep the foot on the block until the release command is given. The foot can be shifted forward on the block to facilitate easy filing of the nail(s). Animals can also be conditioned to permit placement of nails on block so their pad can be thoroughly inspected and trimmed, as needed.

Steady - This command is given when the trainer needs the rhino to hold position for a certain amount of time. For example: When drawing blood, steady is used to keep the animal's leg in position while blood is being drawn.

Phlebotomy procedure (front leg) – Rhinos are generally conditioned to either place legs in desired position or place foot on block for phlebotomy procedures. Initially trainer will need to condition for positioning, then steady command and finally desensitization to venipuncture. Desensitization to venipuncture can start as simple as touching the inner surface of front leg opposite trainer and progress to use of blunted needle, etc. to simulate the pressure and device(s) used for procedure. Remember to bridge and reward animal for maintenance of position during this process since that will be a required behaviour for this process. Once you progress to the actual venipuncture itself, you may have to do initial stick, reward/re-focus animal, repeat steady command, and then finally proceed to repositioning needle for phlebotomy process. In most rhino species proper conditioning will enable blood samples to be taken from the ear, base of tail, front or rear legs.

Vein on opposite leg

Initial Stick

Down - The correct response to this command is to lie down sternal, parallel to the bars. To get some animals to lie down the trainer brings either side of the rhino over to the barriers, using the command “over”, and then use a physical cue such as rubbing the rhino’s back or the inside of the back legs to encourage them to lie down. The final result will be animals placing themselves in a sternal position parallel to barrier. This behaviour has so been trained via shaping and the use of the “target”.

Cue – Rubbing the rhino's back

Result Sitting Position

Chute/restraint Training

The use of a chute to restrain and/or confine the animal can be helpful in preventing the rhino from moving excessively during a procedure, which could cause injury to the animal or trainer. The first step in restraint training is getting the animal comfortable entering the device. Animal can either be "targeted" into the chute, or use successive approximation to progress to the end goal of entering the chute. Depending on the construction of your particular restraint, it may advantageous to have restraint in the fully open position during this initial phase then progress to shutting the front door, and finally progressing to full confinement. To shape the entrance behaviour, the animal is rewarded for making progress towards the chute. For example, if the animal is standing just outside the chute, for each step it takes towards the chute the animal is bridged and rewarded until it is completely within the restraint.

Once the animal is in the restraint, it is a good idea to get the animal comfortable remaining in the chute for a period of time and "bridging" for calm demeanour while within the restraint before training any other behaviour within the device.

Trainer must remember to desensitize animal (and reward calm demeanour and attitude) to the visual and auditory sounds of door movement in front and behind animal and any other moving parts of the device before progressing to training additional behaviours.

Some common commands and behaviours associated with the chute are:
Steady – Command given to have the animal remain in the desired position
(i.e. if the rhino's foot is on a block).
Over or Lean in – Command given to have the animal step, or move the entire body closer to the wall of the chute.
Back – Command given to the have the animal step backwards, either for positioning or exiting the chute.
Move Up – Command given to have the rhino step forward for positioning, can also be used to enter/exit the chute.
Foot – This is used generally to place a foot on a block, or to position it in a way to draw blood.
Ear – Command given to relax the ear to draw blood.
Tail – Command given to relax the tail, which allows the trainer the ability to manipulate the tail in the desired position, either for blood draws, or rectal ultrasound/palpations.

(IRKA, 2010b)