

Research in the northern white rhino at Dvur Kralove Zoo, 1986-1990



*Anaesthetising a female (zc)*



*Examining and dehorning northern white rhinos, 1986 (zc)*



*An anaesthetised female (zc)*



*Miroslav Svitalsky collecting semen (zc)*

It was proposed that the rhino herd be split and a part of the animals transferred into another zoo, where they had achieved success in reproduction of the southern subspecies to reduce the risk of possible decimation of the only captive animals held at a single location based on unexpected health problems. Subsequently, it was decided following several meetings upon recommendations of conservation organisations that 3 (1.2) individuals, namely male Saut and females Nadi and Nola, would be transferred to San Diego WAP, the USA; this institution was preferred to the safari park in England's Whipsnade, as it had more favourable climate being placed in sunny California, where the rhinos could be permanently kept outdoors, plus this safari park could boast the largest number of southern white rhino calves in the world and a large research institute. Everyone believed the climate would resolve the breeding issues in the females, who had been found to have almost no cycles. On 30 September 1988, a loan agreement was drawn up based on which 3 rhinos from Dvur Kralove were to be loaned to San Diego WAP, namely male Saut and females Nadi and Nola, then 14 and 16 years old, and a management committee was formed with representatives of Dvur Kralove, San Diego WAP, CBSG/IUCN and the Zoological Society London. The partners committed under the agreement to provide Dvur Kralove Zoo with Arabian oryxes and three young gorillas for breeding purposes - a male and two females. While the three northern white rhinos departed into the USA about one year after, Dvur Kralove obtained Arabian oryxes and a young gorilla male Assumbo, who however had been hand-reared and kept many years apart from the gorilla groups, which caused him being not able and willing to mate with the gorilla females kept in Dvur Kralove. The other two gorilla females were never supplied to Dvur Kralove as promised and the agreement failed to be observed and fulfilled in this regard, despite repeated negotiations that followed. On the other hand, visitors driving through the northern white rhino enclosures at San Diego WAP are informed of the fact that the animals had been loaned from the Czech Republic.

On 13 October 1989, the three northern white rhinos - 15 and 17 years old at that time - were loaded in Dvur Kralove into the crates made by the zoo personnel and carried away by trucks, at first to the Frankfurt a/M international airport. From there the rhinos were flown all the way to the USA- San Diego airport, with subsequent transport to the San Diego Zoo's Wild Animal Park 45 kilometres away, where the animals were kept within a 45-hectare area that they shared with other African ungulates and birds.

In the interim period, Dvur Kralove still continued to stimulate the females through modified diet (1988) and hormonal treatment (1988 and 1989). On 2 August 1989, mating of Nesari with Sudan occurred, giving the zoo a hope, which however was not fulfilled.

Subsequently, the most recent Nasima's daughter Najin DK 7 was weaned from her mother in Dvur Kralove on 21 June 1990 when the calf was less than a year old, and Nasima united on 23 June with a group of 3 females (Nesari, Nabire and Nasi); immediately after, Nasima was introduced to Sudan in the outdoor enclosure, and mated by the male as early as 5 July and subsequently on 1 August, 28 August and 24 September. Nasima became pregnant 3 months after first united with the herd and introduced to the male. Najin DK 7 lived from her birth in the former rhino house, where she was gradually grouped with two young black rhinos; at first, it was with a two-year-old male (Jos DK 7) on 2 July 1990, and then with a two-year-old female (Sany DK 8) on 1 August 1990; these three animals were kept together at the rhino house as well (see photo on page 1).

In the meantime, the aged male Ben had to be euthanised on 25 June 1990 for overall decrepitude and disability of standing up. This rhino was 40 and weighed less than 1,200 kg (1,460 kg earlier in August 1989).

The team of Dvur Kralove researchers was still in the process of looking for a method of inducing cycling in females. Until the time of completion of the new rhino house, the existing enclosure was modified as of 1986: the ditches were lined by stones to avoid the risk of throwing a female down into the ditch and enable the female group being put together with the male on a daily basis, as until that time, females used to be kept with males outdoors only for short periods during oestrus as a result of several cases of falling into the ditch. Following the modification described above, the male could stay out with the females all day long.

At the same time, it was suggested that oestrus could be stimulated by modifying the lighting schedule (applied from the horse breeding) and diet (by applying the varied quality of feeds in dry and rainy periods in the wild). In 1989, the new house designed above all for northern white rhinos was finished; the northern whites were chiefly housed in the western section of the building, with an adjoining outdoor enclosure assigned for keeping the northern white rhino herd of nearly 3,000 m<sup>2</sup> (for more details refer to page 56). The first rhino taken into the house was male Ben in August 1989.



*Northern white rhinos in the outdoor enclosure #3 by the rhino house 2 (az)*



*A dry moat along the northern white rhino enclosure lined with stones preventing falls (zc)*

From autumn 1990, i.e. at the new rhino house, the zoo implemented a controlled light regime including darkening windows and lighting inside the house with the aim of photostimulating the animals. This was preceded by relocation of the northern white rhino group into the new rhino house in October 1990. In addition, each of the females was kept in a separate stall at night and the group with the others only outdoors during the day. This was the first case of implementing separate housing of each female at that time - only female Nasima had been kept apart, until 1985 as mentioned above. To provide an additional breeding stimulus, a southern white rhino pair (Frankie and Sanni) was imported and housed in the neighbouring stalls inside the building; alternating the northern white rhinos in the outdoor enclosures, the pair was later incorporated into the group. Female Sanni, then 26 years old, was injured by Sudan; the male's horn injured the female's groin and torn her rectum. The wound was treated by the most experienced rhino keeper, Miroslav Svitalsky, who had been caring for the rhinos since they arrived from Africa. Sanni attacked the man, wounding him to death. Today it is apparent that providing too old and non-breeding animals to stimulate oestrus in the northern white rhino females was inadequate and fully useless, plus with such cruel consequences; it is hard to understand why young or cycling females could not be supplied from European collections, for instance from Whipsnade, when the meetings concerning the rhinos were also attended by a representative of the Zoological Society London that manages the safari park above.

On 17 July 1991, prolapsed vagina and signs of abortion appeared in Nasima. The female was treated with big difficulties and the placenta with the calf inserted back into vagina. Despite every effort, Nasima aborted her fourth daughter DK 8 on the next day - the pregnancy day 296. The foetus weighed 17.3 kg. Nasima was then subject to treatment, upon which the female recovered, but the chances of giving birth to a full-term calf were disappearing.

In the late 1992, stimulation of breeding through diet control was launched, when the quantity of concentrated feeds and quality of the diet was reduced. Four months later in the spring, the ration was significantly enriched in terms of both quantity and quality and supplemented by vitamins. The aim was to imitate the variations in diet in a similar manner as it takes place over the rainy periods in the wild. At the same time, the females were split into two groups, where females Nesari (17 years) and Sanni (southern white, 28 years) were being introduced to Suni (11), while Sudan (17) was put together with females Nasima (26) and Nasi (14).

The young Najin DK 7 was kept since weaning in the former rhino house (rhino house 1) with young black rhinos.

In the early 1990s, research in the northern form was still underway, with experts from abroad asking the zoo repeatedly to collect samples for analysis. This became fatal for Nasima, who blocked her horn in the restraint corridor while being sampled for skin tissue despite having been trained for the sampling procedure; the animal subsequently died of collapse. Training for sampling was underway from May 1991 using a restraint corridor constructed by the new rhino house. The procedure went smoothly until 28 June, when Nasima lied down in the chute, blocking her horn so unfortunately that she was unable to stand up. In the subsequent panic, the rhino was shocked and died as a result of heart collapse. The female was 26 years old and weighed 1,680 kg.

Needless to mention that skin samples for genetic analysis to be performed in the USA had been collected from all rhinos for primary research in the preceding years, and the results clearly confirmed the genetic difference of the northern form; in addition, analysis of the karyotype was undertaken by Dr Oliver Ryder in the USA (1984), who found a chromosomal abnormality with suspected Robertsonian translocation in Sudan and his descendants. This in fact means fusing of two chromosomes, so certain individuals have only 81 chromosomes instead of 82. This chromosomal translocation was found in Sudan and his daughters Nabire and Najin, while Nasima, Saut and their son Suni had 82 chromosomes. Many years later, a descendant of Najin (81 chromosomes) and Saut (82 chromosomes) was found to have 82 chromosomes (Fatu DK 9).

As mentioned above, within the efforts to make the rest of the animals breed, which was backed up by the international community, 3 (1.2) animals were sent on loan to San Diego Wild Animal Park, California, in October 1989. However, even this institution failed to make the rhinos reproduce despite recurrent efforts of the local team of researchers and scientists, import of male Angalifu from Sudanese Khartoum Zoo as early as 1990 and repeated mating of male Saut and female Nola in 1995, which was however preceded by hormonal stimulation of both females. Therefore, San Diego WAP was asked in 1997 to return male Saut who was fully unrelated to the young Najin DK 7, which took place in the summer 1998. Much later, in 2006, one ovary was removed in female Nola at San Diego WAP, without consent and awareness of Dvur Kralove Zoo. Examination found atrophy and complete loss of function of the ovary, and the females in San Diego were no longer able to reproduce. Male Angalifu was sampled for semen by the IZW Berlin team, who found that the male's sperm was not suitable for natural reproduction (reduced motility, sperm cells partly damaged). In late May 2007, female Nadi died in San Diego, and the 37-year-old female Nola is now kept alone in the park as evidenced by the picture taken in the autumn 2009.



*Northern white rhinos in the outdoor enclosure by the rhino house 1 during the construction of a shelter with black rhinos in the back, 1986 (lh)*

**Transport of three northern white rhinos to San Diego WAP, the USA, in 1989**



*Saut, Nadi and Nola prior the transport into the USA*



*Zdenek Barta by the enclosure prior the transport (zc)*



*Loading the rhino triplet in 1989 (zc)*



*Loading a crate containing a rhino prior departure into the USA (az)*



**Dvur Kralove's northern white rhinos at San Diego WAP: 1989-2009**



*Saut, Nola and Nadi at San Diego WAP (az)*



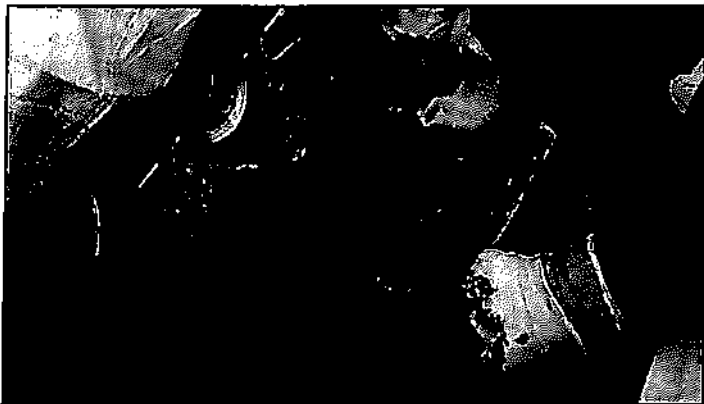
*Nola at San Diego WAP (dh)*



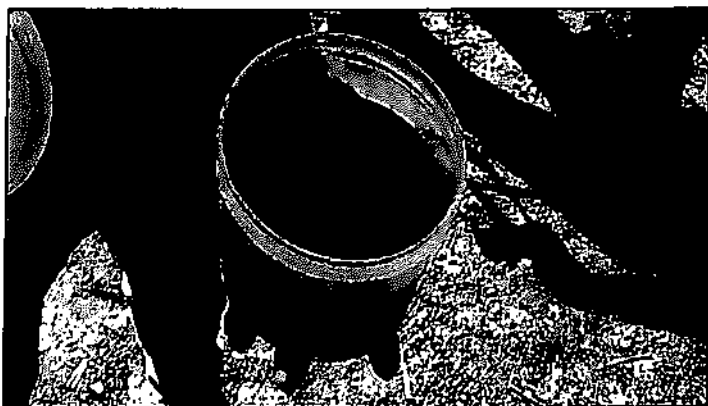
*Nadi at San Diego WAP (dh)*



*Saut and Nola mating at San Diego WAP in 1995 (az)*



*Collecting an ovary from the female northern white rhino, San Diego WAP, 2007 (az)*



*Removed ovary and healed wound after the removal, San Diego WAP (az)*



*Female Nola at San Diego WAP in 2009 (az)*



### Stock history in 1990-2000

In 1994, the rhinos began to be kept constantly together, with the outdoor enclosure modified by replacing the U-type moat by one with gradual slope. One of the reasons for separating the males at night until then was the risk of potential throwing a female by the male into the moat. At the same time, the way the animals were housed indoors was also modified to allow the females communicating with male Sudan on one side and Suni on the other. All females were held in several interconnected stalls. The monitoring of the hormonal activity continued in collaboration with the Vienna Veterinary University; it was found that in virtually every female, including the crossbred Nasi kept together with the female group, levels of sexual hormones increased each time in the latter half of summer and in autumn, supporting the beneficial effects of permanent holding of the male together with the females. In addition to that, none of the females was hormonally stimulated since 1993, with only vitamin E in form of TPGS administered in 1994. Females were mated repeatedly, with Nesari mated by Suni on 9 Jun 1993 and 24 Jan 1994 and Nabire mated by Sudan on 5 Sep 1994; even Najin became mate as well (29 Sep 1997 with Sudan), but no pregnancy ever occurred (HOLECKOVA 2008).

In parallel, the young and thus prospective females Nabire and Najin were put together with their brother (Suni) and father (Sudan) on a rotational basis and it became clear that importing an unrelated male would be necessary. As any opportunity of getting a young male from Garamba fully disappeared at the moment of outbreak of a civil war and establishing a new government in former Zaire, today the Democratic Republic Congo, RNDr Dana Holeckova, Director of Dvur Kralove Zoo, requested San Diego to return male Saut as early as 1996. Having spent a number of years in the USA, Saut was also expected to possibly introduce changes into the female group in terms of female behaviour and sexual attractiveness (HOLECKOVA 2008).

Following two years of discussions and administrative procedures, Saut was returned on 15 July 1998. Having undergone the quarantine period, the male was united with the group of all the four females (Nasi, Nesari, Nabire and Najin) on 19 August. As early as 14 September 1998, Saut mated with Najin some 20 minutes and attempted to mate Nesari on 20 September 1998. Najin was mated again on 28 September, 28 October and 28 November 1998 and then on 5 March 1999. Besides, Saut attempted to mate Nesari on 12 September 1999 and mated with Nabire on 28 September 1999. Testing the hormonal derivatives in the dung showed that all females started cycling and Najin became pregnant following the last March mating (HOLECKOVA 2008).

### Reproductive activities within the female group following uniting with male Saut up to 31 December 2000 (HOLECKOVA 2008).

Najin (born 1988)	Nabire (born 1983)	Nesari (born 1975)
14 Sep 1998: mating, 20 minutes	28 Sep 1999: showing interest	19 Sep 1998: mating attempt
28 Sep 1998: mating, at least 14 minutes	26 Jun 2000: mating without getting pregnant	3-4 Sep 1998: male showing interest in the female
28 Oct 1998: mating, at least 15 minutes		12 Aug 1999: interest in the female
28 Nov 1998: mating attempt		12 Sep 1999: mating attempt
5 Mar 1999: mating, pregnancy confirmed in Dec 1999		28 Nov 2000: mating attempt
29 Jun 2000: birth, following 482 days		

### Baby of the Millennium

The calf was born following 482 days of pregnancy on 29 Jun 2000, at 2.30 am. The birth as such proceeded quickly: Just a minute prior to delivery of the young, Najin lied. Then she got up and gave birth within another minute. Some 30-40 minutes following the birth, the calf was horned by the female several times. Luckily, Jan Zdarek - the experienced rhino keeper - was present, calming the female down and recording the entire birth by a camcorder. The calf - female - started searching for milk, but Najin was evading the attempts at the beginning. Fortunately, the female calmed down very soon and started milking. Saut became a father for the second time after a 20-year break (HOLECKOVA 2008).



The birth as well as the first weeks of the life of the newborn rhino could be watched by anyone interested online (<http://www.rozhlas.cz/mlade>), as the calf was tracked by 5 recorders placed both indoors and outdoors. The baby rhino was first released outdoors with its mother on 7 July when it was 9 days old. From that time on, it walked out on a routine basis. Dubbed the Baby of the Millennium, the young female was the fourth live-born northern white rhino in captivity and the first one born in generation 2 at the same time. Its first small steps around the outdoor enclosure as well as the naming party were shot by several television teams, covered by a number of radio stations, reported in the press by daily and weekly media throughout the country, and abroad. Simultaneously, a competition for the most attractive name was launched. Based on several hundred proposals received, the name FATU was selected, meaning a "Maasai goddess of eternal life" (HOLECKOVA 2008).

#### **Breeding activities since 2000 and cooperation with IZW Berlin (HOLECKOVA 2008)**

The birth of Fatu was a great promise for the future. As early as 2001, Najin was integrated into the herd together with her calf and put together with male Saut, who became mating the female, even in the presence of the young. Dung examinations were giving hope and everything indicated for the fact that Najin had become pregnant in the course of 2001. The female began cycling and mating again in the spring 2002, but pregnancy still did not come.

In 2001, Dvur Kralove Zoo started cooperating closely with IZW Berlin, whose veterinarian experts first specialised in artificial impregnation of elephants, with subsequent launching research into the field of assisted insemination in rhinos. In the partnership with Dr Ch Walzer of Salzburg Zoo, a new and safer method of anaesthetising rhinos was developed, when Immobilon posing risks was replaced by other products, making any deaths of rhinos during examinations rather unique.

All the non-breeding individuals were anaesthetised one by one and their reproductive organs examined using modified ultrasound of special intensity. Females Nesari, Nabire and Nasi were hormonally stimulated repeatedly in 2002 without success, even mating did not occur.

According to dung testing, the hormonal activities of the females decreased to very low levels similar to those shown before Saut's arrival in the group in 1998; by the way, reproductive organs were still functional in all females and nothing was preventing potential pregnancy. Later examinations showed that modifications did occur in Nasi, with tumour found in the female's uterus, due to which the rhino had to be euthanised. Nabire was found to have suffered ovarian cysts and Nesari had become unable to reproduce as well for tumour changes in her reproductive tract.

Saut and Suni were examined repeatedly as well; semen was collected from the males and is currently stored at IZW Berlin. Following the death of Saut in 2006, the male's reproductive organs were transferred to Berlin, where a part of the male's sperm was "saved".

As neither Najin nor her daughter could become pregnant, the zoo proceeded to attempt for artificial insemination. Although two animals were already born following assisted insemination (in the southern white rhino), the rate of success is very low, as the above was based on a total of some 50 inseminations. Najin was inseminated twice, on 11 November 2006 and 22 June 2007, while Fatu even three times - on 20 June and 11 November 2006 and then on 19 June 2007, with fresh semen of Suni used in four cases (for which the male had to be anaesthetised as well) and a single case of use of frozen sperm of this male. Unfortunately, none of the efforts above has led to making the females pregnant, plus 28 immobilisations of the northern white rhinos were carried out as part of IZW Berlin's research activities from 2001 to 2009, meaning a great load put on the animals in the absence of positive results.

The animal management techniques reducing the levels of hormonal activities in the females might have been the very reason for the failure of assisted reproduction in white rhinos despite using the most advanced techniques and technology and profound attitude of experts. Therefore, considering the advanced age of all the four potential breeders, a decision was taken to relocate them into wild conditions, where the rhinos could live on extensive areas in accordance with natural instincts in normal social and territorial relationships. At the same time, their behaviour will be monitored using radio transmitters placed in their horns, among others to find patterns essential for the white rhino to reproduce in a natural way.

#### From 2001 to 2007, IZW Berlin carried out a total of 27 anaesthetisations of the animals, including the following activities:

- Suni (male): 5 cases of sperm collection; a part of semen transferred to Berlin and stored, a part used for insemination.
- Saut (male): 2 cases of sperm collection; reproductive organs collected upon the male's death, sperm stored in Berlin.

- Nasi (female): 4 cases of anaesthetising, 4 cases of inserting a hormonal implant; prior euthanising, ovulation induced and ovaries collected and transferred to Berlin - never got pregnant, euthanised.
- Nesari (female): 3 cases of anaesthetising, 4 cases of inserting a hormonal implant - never got pregnant.
- Nabire (female): 4 cases of anaesthetising, 4 cases of inserting a hormonal implant - never got pregnant.
- Najin (female): 5 cases of anaesthetising, 2 cases of artificial insemination - never got pregnant.
- Fatu (female): 4 cases of anaesthetising, 3 cases of artificial insemination, 1 case of inserting a hormonal implant - never got pregnant.

#### University of Vienna

Dung collection was carried out on a routine basis, with samples examined at the University of Vienna, which involved hundreds of specimens. In addition, the institution was consulted regarding inserting implants and insemination.

All of the above-listed efforts undertaken from 2001 to 2007 failed to result in pregnancy of any female, plus females were kept separated from males a number of months both prior and following the artificial insemination as recommended by IZW, which in fact led to reduced hormonal activities in the females as confirmed by testing hormonal activities from faeces at the Veterinary University of Vienna.

Saut, who died in 2007, mated Najin repeatedly since 2001; however, the female failed to get pregnant, though it is believed she might have aborted in a single case, as shown by the hormonal activity diagram. In 2006 and 2007, the above-mentioned attempts to impregnate Najin and Fatu by assisted insemination were carried out, but without success.

Therefore, Dvur Kralove Zoo initiated in the late 2007 discussions concerning potential involvement of the last remaining individuals able to reproduce in breeding, which resulted in a meeting of specialists held in Dvur Kralove in September 2008, where the majority of experts recommended relocating the rhinos into a safe location in the wild. This was made in December 2009, when males Sudan and Suni, and females Najin DK 7 and Fatu DK 9 were transferred into the Ol Pejeta Conservancy, Kenya.

The following table provides summary of all cases of anaesthetisation in northern white rhinos and crossbred Nasi carried out in co-operation with IZW Berlin in the years 2001-2009. In 2009, Nabire was examined as mentioned earlier, and male Suni sampled for semen, which is now kept frozen in Berlin for potential artificial insemination in future. At the same time, biological samples were collected from all rhinos before the move to Kenya for potential use in future, such as in the case of improvement of "genetic engineering" techniques, etc.

#### **Overview of cases of anaesthetising and examining in the northern white rhinos by IZW Berlin (HOLECKOVA 2008 - amended)**

Individual	Nesari	Nabire	Nasi	Najin	Fatu	Suni	Saut
Checkup #1	30 Jul 2001	30 Jul 2001	21 May 2002	14 Apr 2004	20 Jun 2006	14 Apr 2004	14 Apr 2004
Checkup #2	21 May 2002	21 May 2002	4 Nov 2002	<b>11 Nov 2008</b>	<b>11 Nov 2008</b>	20 Jun 2006	19 Jun 2008
Checkup #3	4 Nov 2002	4 Nov 2002	21 May 2007	21 May 2007	21 May 2007	11 Nov 2008	
Checkup #4		14 Apr 2004	20 Jun 2007	19 Jun 2007	19 Jun 2007	22 Jun 2007	
Checkup #5		16 Jul 2009		22 Jun 2007		10 Sep 2009	

In bold: artificial insemination

Only four animals were moved into Kenya instead of five (i.e. males Sudan and Suni DK 5 and females Nabire DK 6, Najin DK 7 and Fatu DK 9) as originally intended, as examination of Nabire in July 2009 found that this female rhino would not be probably capable of natural reproduction any longer. The remainder animals were shipped to Kenya on 19 December 2009, where the animals arrived on 20 December - refer to Last chance to survive chapter, page 257.

For summary of all imports, births and historical data of northern white rhinos held at Dvur Kralove Zoo, refer to the tables on page 223 and 225.

### Summary of northern white rhino imports to Dvur Kralove Zoo prior to 31 December 2009

(Stdbk # - animal number within the International Studbook; M - male, F - female)

No.	Sex	Name	Stdbk #	Arrival	Birth	Departure / † Death in DK	Comments
1	M	Sudan	372	19 Sep 1975 Sudan	1973 Sudan	19 December 2009 Ol Pejeta, Kenya	
2	M	Saut	373	19 Sep 1975 Sudan	1972 Sudan	14 Oct 1989, San Diego WAP, USA	Return - see #9
3	F	Nola	374	19 Sep 1975 Sudan	1974 Sudan	14 Oct 1989, San Diego WAP, USA	
4	F	Nuri	375	19 Sep 1975 Sudan	1973 Sudan	† 4 Jan 1982	Shock -trauma
5	F	Nadi	376	19 Sep 1975 Sudan	1972 Sudan	14 Oct 1989, San Diego WAP, USA	† 30 May 2007 San Diego WAP
6	F	Nesari	377	19 Sep 1975 Sudan	1972 Sudan		
7	F	Nasima	351	27 Aug 1977 Knowsley, UK	1965 Sudan	† 28 Jun 1992	Collapse
8	M	Ben	19	27 Aug 1986 London, UK	1950 Sudan	† 25 Jun 1990	Euthanised due to high age
9	M	Saut	373	15 Jul 1998, San Diego WAP, USA	1972 Sudan	† 14 Aug 2006	Heart failure

Total animals imported: 9 (4:5), of which 1 (1:0) were imported twice

### Northern white rhinos born at Dvur Kralove Zoo prior to 31 December 2009

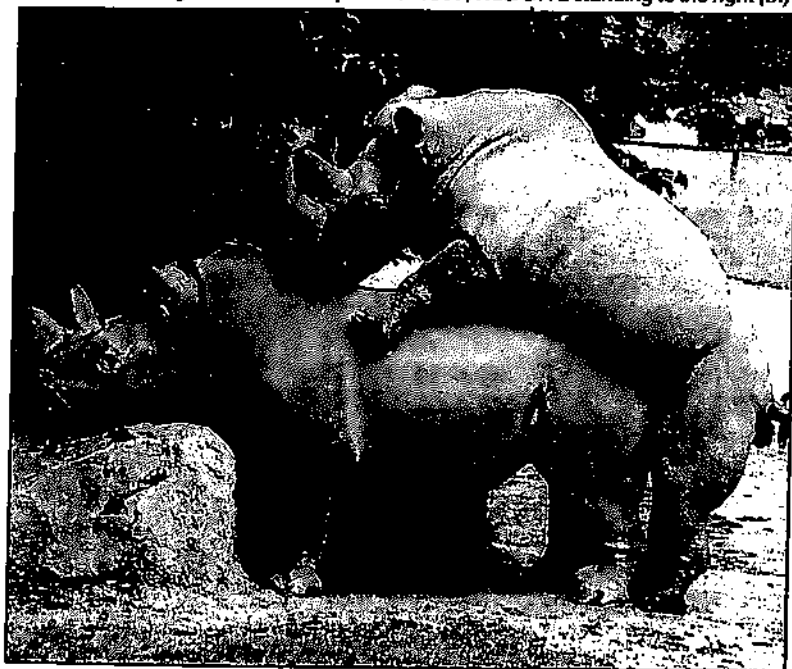
No.	Sex	Name	Stdbk #	Dam	Sire	Birth	Comments
0	F	Nasi DK 1	476	Nasima	Arthur	11 Nov 1977	Crossbred animal, fathered by a southern form animal
1	M	Suni DK 5	630	Nasima	Saut	8 Jun 1980	<b>NWR #1 born in captivity</b>
2	F	Nabire DK 6	789	Nasima	Sudan	15 Nov 1983	
3	F	Najin DK 7	943	Nasima	Sudan	11 Jul 1989	
4	F	— DK 8	1122	Nasima	Sudan	18 Jul 1991	Abort on day 296
5	F	Fatu DK 9	1305	Najin DK 7	Saut	29 Jun 2000	<b>First individual born in generation 2</b>

In bold: still alive (M - male, F - female)

A total of six young were born to the northern white dams, from which the first one (female Nasi DK) was a crossbred animal produced by both subspecies - the only hybrid that was ever born. The remainder animals were descendants of two females and two males.



*Nabire DK 5 being mated on 29 September 1997; Nasi DK 2 standing to the right (th)*



*Saut mating Najin DK 7, 23 June 2003 (th)*

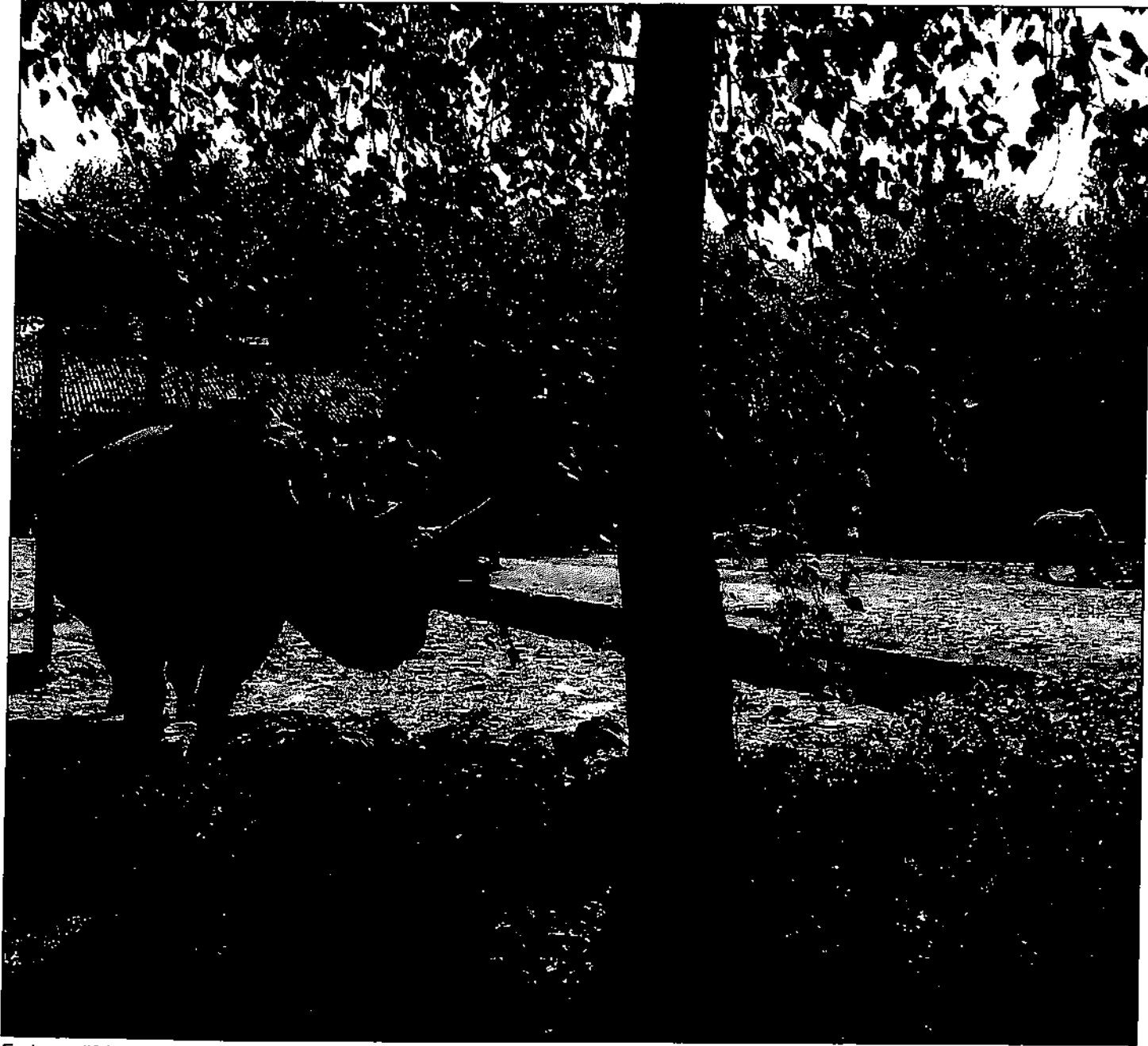


History of the northern white rhino breeding in Dvur Kralove prior to 31 December 2009 (M - male, F - female)

# Name	Sex	IBB/ESB # ARKS #	Birth	Arrival in DK Sire/Dam	Departure from DK	Died	Comments
15/15/DK/0 Saut	M	373 059002	1972 Sudan	19 Sep 1975 Sudan, wild-caught 15 Jul 1998 San Diego WAP, USA	14 Oct 1989, San Diego WAP, USA	14 Aug 2006 Dvur Kralove	1st breeding male Loaned to the USA in the years 1989-1998
16/16/DK/0 Sudan	M	372 059001	1973 Sudan	19 Sep 1975 Sudan, wild-caught	19 Dec 2009 Ol Pejeta, Kenya	-	2nd breeding male
17/17/DK/0 Nadi	F	376 059005	1972 Sudan	19 Sep 1975 Sudan, wild-caught	14 Oct 1989, San Diego WAP, USA	30 May 2007 WAP San Diego, USA	Breeding loan Returned from loan
18/18/DK/0 Nesari	F	377 059006	1972 Sudan	19 Sep 1975 Sudan, wild-caught	-	-	
19/19/DK/0 Nuri	F	375 059004	1973 Sudan	19 Sep 1975 Sudan, wild-caught	-	4 Jan 1982 Dvur Kralove	Trauma, collapse, shock - fell on ice
20/20/DK/0 Nofa	F	307 059003	1974 Sudan	19 Sep 1975 Sudan, wild-caught	14 Oct 1989, San Diego WAP, USA	-	
22/21/DK/0 Nasima	F	351 059007	1965 Uganda	27 Aug 1977 Know- sley, UK	-	28 Jun 1992 Dvur Kralove	Named Twink in the UK Collapse - shock
24/0/DK/2 Nasi DK 2	F	476 059008	11 Nov 1977 Dvur Kralove	Born in DK Nasima/southern form	-	20 Jun 2007 Dvur Kralove	Tumour in uterus, eut- hanised
27/0/DK/5 Suni DK 5	M	630 059009	8 Jun 1980 Dvur Kralove	Born in DK Nasima/Saut	19 Dec 2009 Ol Pejeta, Kenya	-	
28/0/DK/6 Nabire DK 6	F	789 059010	15 Nov 1983 Dvur Kralove	Born in DK Nasima/Sudan	-	-	
29/23/DK/0 Ben	M	019 059011	1950 Sudan	27.8.1986 London Zoo, UK	-	25 Jun 1990 Dvur Kralove	Euthanised due to high age
30/0/DK/7 Najin DK 7	F	943 059012	11 Jul 1989 Dvur Kralove	Born in DK Nasi- ma/Sudan	19 Dec 2009 Ol Pejeta, Kenya	-	2nd breeding female
33/0/DK/8 -DK 8	F	1122 059013	18 Jul 1991 Dvur Kralove	Born in DK Nasima/Sudan		18 Jul 1991 Dvur Kralove	Abort - placed in Nati- onal Museum Prague
35/0/DK/9 Fatu DK 9	F	1305 059014	29 Jun 2000 Dvur Kralove	Born in DK Najin/Saut	19 Dec 2009 Ol Pejeta, Kenya	-	F2 - Baby of the Mil- lennium

Explanatory note - numbers: 15/15/DK/0: 15 - Historical (time) serial number of individual at Dvur Kralove Zoo  
 15 - Historical serial number of import to Dvur Kralove Zoo  
 DK - Dvur Kralove Zoo symbol  
 0 - Historical serial number of birth at Dvur Kralove Zoo

Northern white rhinos in the outdoor enclosures by the new rhino house



*Enclosure #3 by the new rhino house, 2009 (dh)*



*Enclosure #5 by the new rhino house in use by northern white rhinos, 2009 (dh)*



## BREEDING INDIVIDUALS

A total of 7 (3.4) white rhinos became involved in breeding, which included 4 (2.2) northern whites and 3 (1.2) southern white rhinos. More details follow in the tables below, implicating that the first young, Nasima, was fathered by male Arthur from Knowsley Zoo, Prescott, England. Out of all nine animals born, 2 (1,1) southern white rhinos, 1 (0,1) subspecific hybrid and 4 (1.3) northern whites were reared with success; the subspecific crossbreeding occurred at Knowsley Zoo, England, when the zoo kept Nasima, the northern white rhino female.

### Offspring of individual white rhinos at Dvur Kralove Zoo prior to 31 December 2009

(N - northern subspecies, S - southern subspecies)

F/M	Dan (S)	Saut (N)	Sudan (N)	Arthur - Knowsley (S)
Falth (S)	Fali DK 1 Fatty DK 3			
Tessa (S)	Teny DK 4			
Nasima (N)	—	Suni DK 5	Nabire DK 6 Najin DK 7 — DK 8	Nasi DK 2
Najin DK 3 (N)		Fatu DK 9		

### Southern white rhino breeders at Dvur Kralove Zoo prior to 31 December 2009

No.	Stdbk.#	Sex	Name	Number of young born	Number of young reared
1	111	M	Dan	3 (2.0)	1 (1.1)
2	211	F	Falth	2 (1.1)	1 (0.1)
3	210	F	Tessa	1 (1.0)	1 (1.0)

### Northern white rhino breeders at Dvur Kralove Zoo prior to 31 December 2009

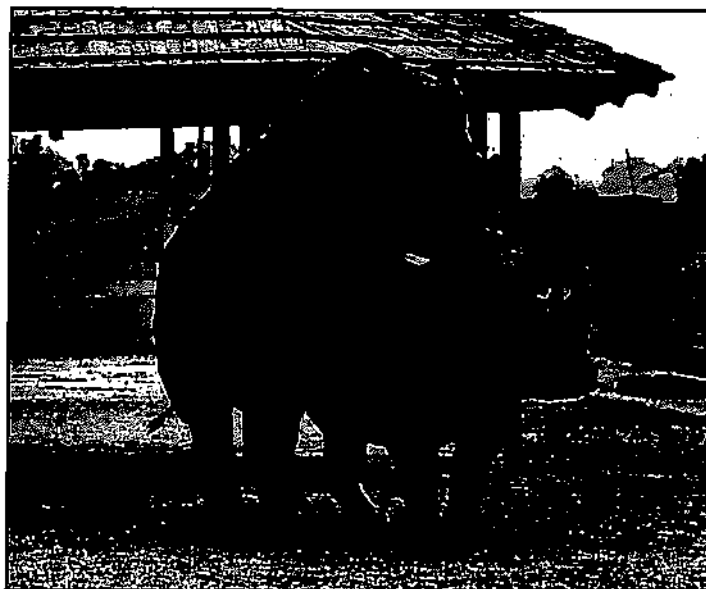
No.	Stdbk.#	Sex	Name	Number of young born	Number of young reared
1	373	M	Saut	2 (1.1)	2 (1.1)
2	272	M	Sudan	3 (0.3)	1 (0.2)
3	351	F	Nasima	4 (1.3)	3 (1.2)
4	943	F	Najin DK 8	1 (0.1)	1 (0.1)

#### Dan (S) - born 1966, Umfolozi, SA; Stdbk #111 († 28 Mar 2008, Usti n/L)

Dan became a father to three calves: a male Fali DK 1, who died of trauma immediately after the birth, female Fatty DK 3 and a male Teny DK 4. Once Dvur Kralove Zoo discontinued the southern white rhino stock, the male left for Czech Usti nad Labem Zoo to become a father to three more animals (3.0), whose mother was female Sasha, with whom Dan left for Usti Zoo from Dvur Kralove in 1980. Dan died in Usti n/L when he reached 42 years.

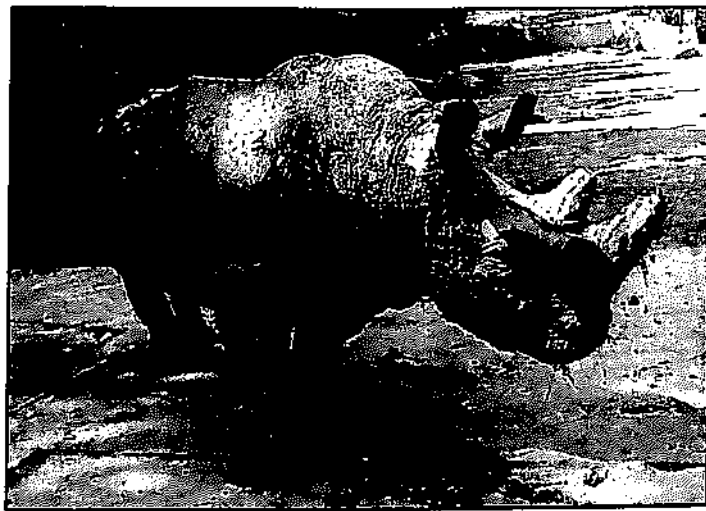


*Dan mating Zamba, 16 July 1976 (lh)*



**Saut (N) - born 1972 Shambe, Sudan; Stdbk #373 († 14 Aug 2006, Dvur Kralove)**

Wild-caught in southern Sudan, Saut fathered two young, the first (Suni DK 3) and the last (Fatu DK 9) northern white rhino born in captivity. In the interim, 1989-1998, the male was loaned to San Diego WAP together with several Dvur Kralove females within the efforts to make additional northern white individuals breed. After returning from San Diego, the male began mating the Dvur Kralove based females, from which Najin DK 8 got pregnant and gave birth in 2000, meaning that 20 years passed between Saut's first and last progeny. Saut died at Dvur Kralove Zoo when he was 36 years old.



*Male Saut after his arrival back from San Diego; to the left, the male is shown with female Nasi, August 1998. (dh)*

**Sudan (N) - born 1973 Shambe, Sudan; Stdbk #372**

Wild-caught Sudan's origin is southern Sudan; the male became father to three calves - females, of which the most recent was born prematurely and dead. Sudan's daughters comprise Nabire DK 6 (born 1983), Najin DK 7 (born 1989) and DK 8 (aborted in 1991). In December 2009, the male returned to Africa as the only one from all the wild-caught animals, moved to the Ol Pejeta Conservancy, Kenya, within the Last Chance to Survive project; for more details, see page 257.



*Sudan mating Nasima (fv)*

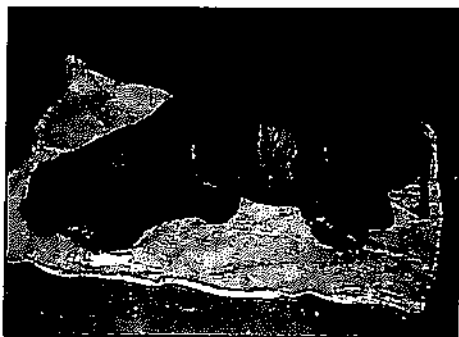


*Sudan mating Nasari (dh)*

**Faith (S) - born 1970, Umfolozi, SA; Stdbk #211**

No.	Sex	Name	Stdbk #	Dam	Sire	Conceived	Birth	Gestation period	House & comments
1	M	Fali DK 1	??	Faith	Dan	6 Apr 1975	15 Aug 1976	496 days	House #1
2	F	Fatty DK 3	530	Faith	Dan	18 Nov 1976	4 Apr 1978	502 days	House #1

Faith first conceived when kept in the company of other southern white rhinos, giving subsequently birth within the group of females, where her first calf (male Fali DK 1) died of trauma. The female became pregnant very soon after that, rearing her second young, female Fatty DK 3, without problems. Faith was sold in 1980 to Katowice, Poland, after the southern white rhino stock was stopped.



*Fali DK 1 on 15 August 1976 (pb)*



*Faith and Fatty DK 3, 21 May 1978 (lh)*



**Tessa (S) - born 13 Sep 1979, Umfolozi, SA; Stdbk #93**

No.	Sex	Name	Stdbk #	Dam	Sire	Conceived	Birth	Gestation period	House & comments
1	M	Teny DK 4	531	Tessa	Dan	30 Jun 1977	16 Dec 1978	534 days	House #1

Tessa got first pregnant when she was 8 years, when staying indoors in the company of other two females, mated by male Dan outdoors. Tessa reared her first and only calf without troubles and departure of this female as a result of discontinued holding of the subspecies to Polish Wroclaw Zoo in 1980, where Tessa spent the rest of her life only in the company of her son Teny DK 4, can be considered unfortunate.



*Tessa and Teny DK 4, 13 June 1980 (lh)*



*Nasi DK 2 - a hybrid of the northern and southern white rhino form (lh)*

**Nasima (N) - born 1965, Uganda; Stdbk #351 († 28 Jun 1992, Dvur Kralove)**

No.	Sex	Name	Stdbk #	Dam	Sire	Conceived	Birth	Gestation period	House & comments
1	F	Nasi DK 1	476	Nasima	Arthur	?	11 Nov 1977	?	House #1
2	M	Suni DK 5	630	Nasima	Saut	?	8 Jun 1980	?	House #1
3	F	Nabire DK 6	789	Nasima	Sudan	18 Jul 1982	15 Nov 1983	484 days	House #1
4	F	Najin DK 7	943	Nasima	Sudan	17 Mar 1988	11 Jul 1989	481 days	House #1
5	F	—DK 8	1122	Nasima	Sudan	24 Sep 1990	18 Jul 1991	Abort on day 296	New rhino house (#3)

Nasima came from Knowsley Zoo, England, where she was called Twink; when she arrived, she was already pregnant, of which no one was aware. Surprisingly, she gave birth to her first calf - female Nasi DK 2 - as early as 2.5 months after; the calf was an inter-specific hybrid, as her father was a southern white male Arthur, Stdbk #355. Consequently, Nasima was repeatedly united with northern white males and bore 4 (1.3) pure northern white rhinos fathered by Saut (1 animal) and Sudan (3 animals). Sadly, the last calf was born prematurely and dead. Nasima died of collapse when 27 years old. As soon as Nasima finished rearing of Nabire DK 6, she was introduced to male Ben, Stdbk #19, imported from London; however, Ben was unable to mate, so the following young were fathered by Sudan, as Saut had been located at San Diego WAP since 1989.



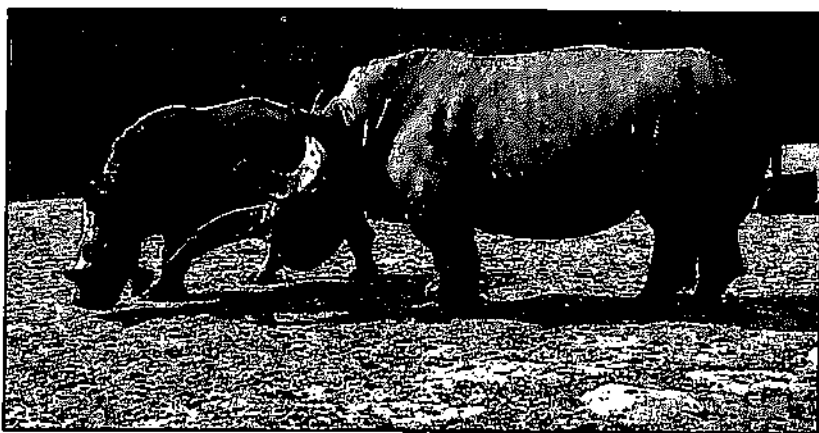
*Nasima and Suni DK 5, 25 November 1980 (lh)*



*Nabire DK 6, 11 February 1984*



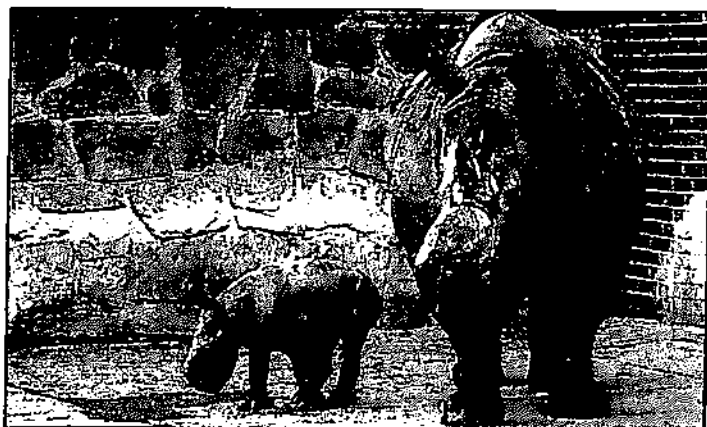
*Nasima and Nabire DK 6, 9 May 1984 (lh)*



*Nasima and Najin DK 7, 15 Apr 1991 (lh)*



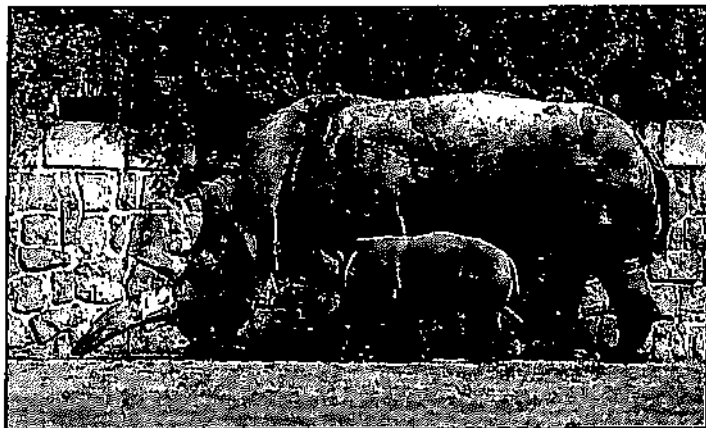
*Najin DK 7 after the birth (zc)*



*Nasima and Najin DK 7, 15 Jul 1989 (lh)*

Najin DK 7 (N) - born 11 Jun 1989, Dvur Kralove; Stdbk #943

No.	Sex	Name	Stdbk #	Dam	Sire	Conceived	Birth	Gestation period	House & comments
1	F	Fatu DK 9	167	Najin	Saut	5 Mar 1999	29 Jun 2000	482 days	New house (#3)



Nasima and Najin DK 7 (zc)



Saut and Najin DK 7 mating, September 1998 (ag)



Najin DK 7 and two-week-old Fatu DK 9, 2000 (dh)



Fatu DK 9 when several weeks old (lh)

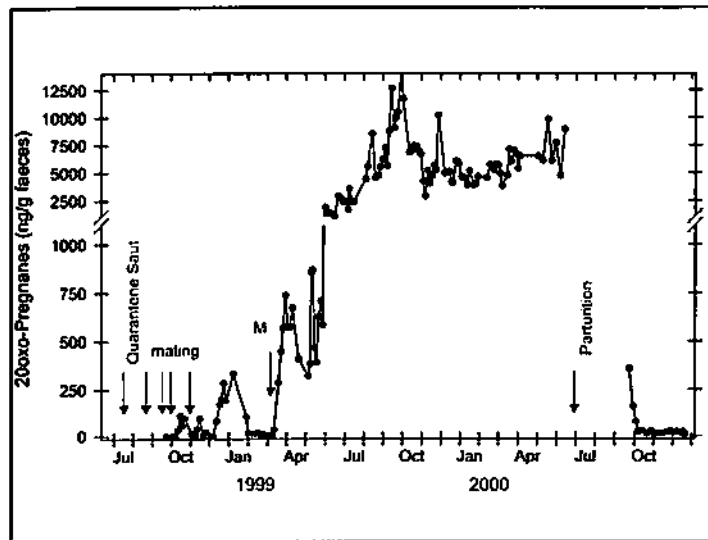
Najin first conceived only after the return of Saut from San Diego (August 1998); according to testing her hormonal activities, the female in fact never cycled before. First mated in September 1998, Najin became pregnant following mating in March 1999 and reared her only calf so far, female Fatu DK 9, called also the Baby of the Millennium, without any trouble.

Najin was reunited with the female group before her calf reached its first year; after a month, she was periodically introduced to male Saut within the group of females, which however did not result in pregnancy despite repeated mating. when the first mating occurred as early as two weeks after the animals were united (21 Jul 2001), with subsequent mating activities on 27 Aug, 10 Oct and 5 Nov 2001. On 7 Dec 2001, only an attempt to mate was recorded. Mating also occurred in 2002 (25 Jan, 19 Mar, 14 Apr, 22 Jun, 24 Sep and 19 Nov) and 2003 (25 Mar, 17 Apr, 23 Jun, 21 Jul and 14 Sep, with additional mating attempts observed on 11 and 12 Oct, 8 Nov and 4 Dec). As Najin still could not conceive, she was anaesthetised in 2004 and first examined by the team of vet experts from IZW Berlin, who found that

the female was fully sound with nothing that might have prevented her to get pregnant. Further, male Saut was anaesthetised and tested, sampled for semen that was found to be of good quality, with 86% motility, so even in this area, no reason was found for Najin failing to get pregnant. Finally, Suni was anaesthetised and examined as well, and found to have sperm with 88% motility. Over the year 2004, Najin and Saut mated on 19 Apr, 27 Jun - an attempt recorded, 25 Jul, 1 Oct and 30 Dec. In 2005, Saut was replaced by Suni in the female group, who attempted to mate Fatu on 24 and 25 July and Najin on 4 August. The hormonal activity testing found Najin to have had an irregular cycle (SCHWARZENBERGER). In 2006, Saut returned to the group of females and mated Najin on 16 June. In the same period, Fatu was anaesthetised and first examined by the IZW Berlin team, confirmed healthy and first inseminated by fresh semen of Suni using AI. As with Saut, Suni was anaesthetised to perform sampling. Subsequently, two northern white rhino groups were established, when Saut was kept with Najin, Nasi and Nabire, while Suni was held in the company of Fatu and Nesari. Suni tried to mate Nesari repeatedly during July, and Saut attempted for the same with Nabire and Najin during August. Sadly, Saut died quietly of heart failure on 14



*Najin with Fatu three hours after the birth (am)*



*Najin's pregnancy confirmed through examining hormonal derivative from the dung (Schwarzenberger 2000)*



*Fatu DK 9, a month old, 2000 (dh)*

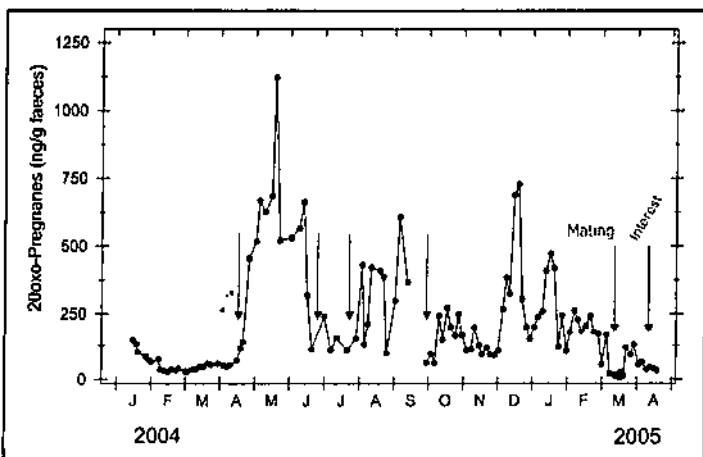


*One-year-old Fatu DK 9 with her mother Najin DK 7, 29 June 2001 (dh)*



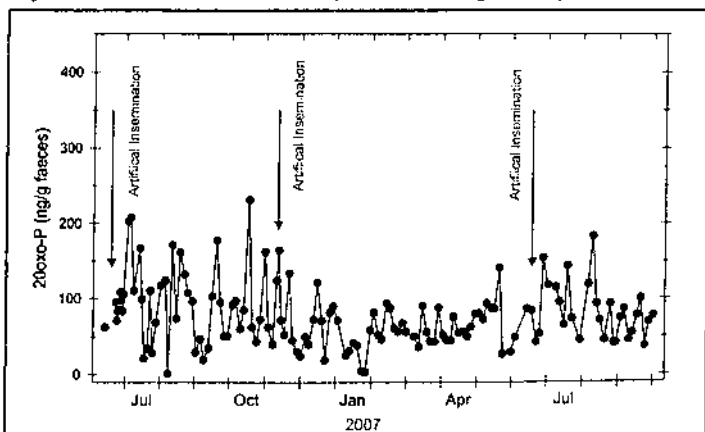
August 2006. In November 2006, artificial insemination was carried out by the IZW Berlin team in both Najin and Fatu, using Suni's sperm again. As recommended by IZW, all females were subsequently kept together, but without a male. In May and June 2007, attempts of artificial impregnation of both Fatu and Najin were carried out again by IZW Berlin; however, as with the previous cases, even repeated attempts of artificial impregnation failed to result in desired pregnancy in these females, sound and prospective in terms of reproduction organs. Following the artificial insemination above, the zoo continued to keep the females without a male as requested by IZW Berlin. Testing hormonal derivatives in the dung then revealed that the hormonal activities of the females were on the decline. Any increase did not occur before the females were reunited with a male, which was Sudan as of May 2008, but neither additional mating nor two AI attempts made Najin pregnant again. The reason was the absence of hormonal cycle. In December 2009, Najin left for Kenya with her daughter Fatu DK 9 within the Last Chance to Survive project; more details are available on page 257.

In cooperation with the Veterinary University of Vienna, we monitored the female cycle and pregnancy by testing faeces. Dr Franz Schwarzenberger developed a methodology by which pregnancy can be diagnosed based on placental progesterone metabolites (SCHWARZENBERGER 1995a), which we used in all types of rhinoceros. The results of female Najin tests are shown in the following charts.



*Najin - hormonal activities in 2007 (Schwarzenberger 2008)*

*Najin and Saut mating, 17 June 2006 (th)*



*Fatu - hormonal activities and artificial insemination in 2007 (Schwarzenberger 2008)*

*Fatu DK 9 watching mating her parents mating, 2004 (dh)*

## BIOLOGICAL DATA

### Gestation and cycle length in females

As copulation in the white rhino typically lasts several tens of minutes, data regarding pregnancy, and even length of cycle in females could be successfully collected. The length of the cycles resulting in pregnancy in females was about 30 days (25-32); in a single case of the second pregnancy in Faith, it was 75 days, which could be due to failure to record one oestrus period, so the cycle could actually last only a half of the period in the event above; alternatively, this could be due to the fact that Faith had entered oestrus and was mated as early as 20 days following the preceding birth, when her calf died. The pregnancy period recorded ranged from 481 to 534 days, 496.5 days on average ( $n = 6$ ). The cycle length in females ranged from 25 to 32 days. Maximum length of copulation was 45 minutes, while the minimum period was 15 minutes.

The regular and irregular cycle length in the white rhino provided by SCHWARZENBERGER (1995a) is 10 weeks and 20-45 days, respectively; in addition, this author reports that over 50% of females in captivity show neither cycle nor ovulation. HERMES *et al.* (2007) provide the length of cycle in the white rhino to be 30-35 or 65-70 days, where only the shorter of the two results in pregnancy; at the same time, they confirm the existence of long periods without cycling in many white rhino females, both young and older ones.

### Mating, length of cycle and gestation period in white rhinos at Dvur Kralove Zoo prior to 31 December 2009

No.	Pair	Mating date / time	Cycle length	Birth	Name	Gestation period (days)
1	Faith x Dan	7 Mar , 6 Apr 1975	30 days	15 Aug 1976	Fall DK 1	496 days
2	Nasima x Arthur	? Knowsley Safari Park, England	?	11 Nov 1977	Nasi DK 2	?
3	Faith x Dan	4 Sep, 18 Nov 1976	75 days (about 32 days)	4 Apr 1978	Fatty DK 3	502 days
4	Tessa x Dan	15 Feb 1975, 18 Oct 1976, 30 Jun 1977	?	16 Dec 1978	Teny DK 4	534 days
5	Nasima x Saut	20 Nov (20 min), 22 Nov 1978, ?	?	8 Jun 1980	Suni DK 5	?
6	Nasima x Sudan	23-24 Jun , 18 Jul 1982	25 days	15 Nov 1983	Nabire DK 6	484 days
7	Nasima x Sudan	12 Aug, 18 Sep, 17 Oct, 18 Nov 1986 (15 + 25 min), 10 Jun, 12 Aug, 13 Sep (17 min) 1987, 14 Jan (45 min), 13 Feb (40 min), 17 Mar 1988 (30 min)	29-32 days	11 Jul 1989	Najin DK 7	481 days
8	Nasima x Sudan	5 Jul, 1 Aug, 28 Aug (40 min), 24 Sep 1990	27 days	18 Jul 1991	— DK 8	Abort on day 296
9	Najin x Saut	14 Sep, 28 Sep, 28 Oct 1998, 5 Mar 1999	30 days	29 Jun 2000	Fatu DK 9	482 days
Gestation time: 481-534 days (496.5 on average)			25-32 days			

### Sex ratio

Out of the nine calves born at Dvur Kralove Zoo, 3 animals were males and 6 were females, with male to female ratio 1:2. Incorporating the Usti n/L Zoo data, where in fact animals originating from Dvur Kralove reproduced three times, produces the sex ratio 1:1, with a total of 12 young (6.6).

Comparing the data obtained from the safari parks in Whippsnade, Beekse Bergen and Knowsley, where 90 calves were born with the sex ratio 53 males and 37 females as determined (ISIS - ARKS), then these produce the sex ratio 1.43:1 for the benefit of males.

## Birth distribution over the year

The following table shows the distribution of births at Dvur Kralove Zoo prior to 2009, as well as in captivity according to the International Studbook (FRESE 2009), summarising the data until 2009. The data collected at Dvur Kralove Zoo clearly indicate the low number of births, while confirming distribution of births throughout the year, which is additionally supported by the figures obtained from the International Studbook comprising 787 births distributed throughout the year, with 6 to 11% of births per year. Similarly, the data from Garamba National Park collected within the observation of local northern white rhinos (SMITH *et al.* 1995) are showing 22 births recorded throughout the year except for November, with three births per month in June, July and September, and one birth per month from March to May.

### Distribution of births over the year in the white rhino at Dvur Kralove Zoo and in captivity prior to 31 December 2009 (FRESE 2009)

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Number of births	0	0	0	1	0	2	1	1	0	0	2	1	8
% per month	0%	0%	0%	12.5%	0%	25%	12.5%	12.5%	0%	0%	25%	12.5%	100%
Of which southern form	0	0	0	1	0	0	0	1	0	0	0	1	3
% per month													
Births in captivity prior to 2009	77	47	55	51	53	44	57	71	75	80	90	87	787
% per month	10%	6%	7%	6%	7%	6%	7%	9%	10%	10%	11%	11%	100%

## Birth intervals and reproductive age

As implied by the table below, birth interval related data were collected in three females, when the figures related to the southern female Sasha come from Usti n/L Zoo, where this animal had lived since 1980, giving births in the period from 1986 to 1993.

While Faith and Tessa became first pregnant when nearly 5 and 7 years old, respectively, Nasima and Najin first conceived when between year 9 and 10, and Sasha (Usti Zoo) only became pregnant after reaching her 18th year of age. The age when the females last conceived was 23.5 and 25.5 years in Nasima and Sasha, respectively. The remaining females are still found within their breeding age (Najin and Fatu), or have never lived in a potential breeding situation after the Dvur Kralove stock was stopped, when Faith left for Katowice and Tessa was kept only in the company of her son at Wroclaw Zoo until the end of her life. The oldest female giving birth was Sasha, who last delivered when 27 years old, and then never got pregnant again until her death, which occurred when she was 42 years old.

It results from the captive-based data prior to 2009 (FRESE 2009) involving 232 females and 791 calves that the age range of the youngest females giving birth was 4 to 5 years, the oldest primigravid females were 20-25 years old and the oldest females giving birth were 35 to 37 years old, while the maximum number of calves per female was 10 to 15 (Mfolozi, Stdbk #159, a female that has been living in San Diego WAP, USA, from 1971 to 2003 and lived to be 40 years old).

Birth intervals were related to the rearing method, as the females, except for Najin, used to be separated from the group prior birth and during the rearing period and not reunited with a male before the young was weaned. Najin was reunited with the female group before her calf reached its first year; after a month, she was periodically introduced to Saut within the group of females, which however did not result in pregnancy despite repeated mating. Other females used to be reunited with a male within the female group following weaning, which typically resulted in the females becoming pregnant very soon, which was the case of Nasima as well; however, this animal was permanently kept amongst a female group even indoors between her birth 3 and 4, and at that very time, the female started to show not very intense oestrus periods, mating very rarely and never getting pregnant. The fourth pregnancy in this female could probably relate to the import of male Ben from London, to whom Nasima was introduced as a single female, thus separated from the group. As Ben was unable to mate anymore due to the high age and health status, the female was introduced to Sudan, getting pregnant quite quickly.

The shortest birth interval was recorded in Faith - 21 months, with the female becoming pregnant 95 days following the preceding birth, when the calf died immediately after the birth and Faith was first mated as early as day 20 after the birth. Nasima usually displayed birth intervals 2 years to 2 years and 7 months. FRESE (2009) reports the shortest intervals between births (full-term calves only) to be 451 to 458 days, i.e. 15 months.

Males first fruitfully mated between year 7 (Saut) and 9 (Dan and Sudan), and last copulated when 26 (Dan) and 27 (Saut) years old.

It results from the captive-based data up to the end of 2009 (FRESE 2009) involving 141 males and 779 descendants that the youngest mating males were 3 to 5 years old - there was even a case of mating when the male was only two years (Stdbk #536), the highest age in first fruitful mating was 22 to 38 years and the oldest mating breeding males were 39 to 47 years; there was a even case of a male with 64 descendants (Stdbk #52 - Mandhla, who lived in WAP Sand Diego and other locations around the USA from 1962 to 1984 and reached the age of 26 years).

**Age at time of birth and birth interval in white rhino females at Dvur Kralove Zoo prior to 31 December 2009**

Females * Born	Birth No.	Birth	Female's age at delivery	Female's age at mating (about 18 months prior birth)	Interval between births	Reared
Faith, Stdbk #211 - S *1970, Umfolozi	1	15 Aug 1976	6 years	4-5 years	—	No
	2	4 Apr 1978	8 years	6.5 years	1 year and 9 months	Yes
Tessa, Stdbk #210 - S *1970, Umfolozi	1	16 Dec 1978	8-9 years	7 years	—	Yes
Nasima, Stdbk #351 - N *1966 Uganda	1	11 Nov 1977	11 years	9.5 years	—	Yes
	2	8 Jun 1980	14 years	12.5 years	2 years and 7 months	Yes
	3	15 Nov 1983	17 years	15.5 years	2 years and 5 months	Yes
	4	11 Jul 1989	23 years	21.5 years	5 years and 8 months	Yes
	5	18 Jul 1991	25 years	23.5 years	2 years	No
Najin, Stdbk #943 - N *11 Jul 1989, Dvur Kralove	1	29 Jun 2000	11 years	9 years and 8 months	—	Yes
Sasha, Stdbk #114 - S *1966, Umfolozi At Usti n/L Zoo	1	18 Nov 1986	20 years	18.5 years	—	Yes
	2	13 Jan 1991	25 years	23.5 years	4 years and 2 months	Yes
	3	10 Dec 1993	27 years	25.5 years	2 years and 11 months	Yes

**The age of the first fruitful mating in male white rhinos at Dvur Kralove Zoo prior to 31 December 2009**

Male * Born	No.	Mating	Male's age at mating
Dan, Stdbk #111 - S *1966, Umfolozi	1	6 Apr 1975	8-9 years
	2	18 Nov 1976	10 years
	3	30 Jun 1977	11 years
	4	June 1985	21 years at Usti n/L Zoo
	5	October 1989	23 years at Usti n/L Zoo
	6	September 1992	26 years at Usti n/L Zoo
Saut, Stdbk #373 - N * 1972, Sudan	1	February 1979	7 years
	2	5 Mar 1999	27 years
Sudan, Stdbk #372 - N * 1973, Sudan	1	18 Jul 1982	9 years
	2	17 Mar 1988	15 years
	3	24 Sep 1990	17 years

In Garamba National Park, birth interval recorded usually ranged from 21 to 28 (32) months. There were two cases of about double birth interval (53 and 69 months); however, there might be births in the meantime that stayed unrecorded (SMITH et al. 1995). Data from the study above are summarised in the table below.

Birth intervals in northern white rhino females, Garamba NP (according to SMITH et al. 1995)

Females Born	Birth No.	Birth	Interval between births
Mama Giningamba	1	February 1985	—
	2	October 1987	2 years and 8 months
	3	August 1989	1 year and 10 month
	4	July 1991	1 year and 11 months
Boletina	1.	August 1983	—
	2	May 1985	1 year and 9 months
	3	September 1987	1 year and 9 months
	4	August 1989	1 year and 11 months
	5	January 1992	2 years and 5 months
	6	January 1994	2 years
Kunalina	1	September 1983	—
	2	July 1985	1 year and 10 months
	3	December 1989	4 years and 5 months
	4	September 1991	1 year and 9 months
	5	July 1993	1 year and 10 months
Mama Moke	1	June 1983	—
	2	March 1989	5 years and 9 months
	3	February 1991	1 year and 11 months
	4	June 1993	2 years and 4 months
Pacque	1	March 1986	—
	2	June 1988	2 years and 3 months



Female Nasi DK 2 was the only world's hybrid of both white rhino subspecies, 2002. (lh)

### Weight in white rhinoceroses

Over the years, a number of weight-related data were obtained, which initially was at random, usually in connection with the transport of the animal; after 1986, this activity became scheduled, which in particular started once a scale had been installed in the new rhino house in 1993, allowing for weighing of adult animals (HOLECKOVA 1995). Even though white rhinos walked to the scale placed in the outer corridor without troubles thanks to the calm nature of these creatures, this action demanded considerable handling as the scale was located at the other section of the house, which was not the one in which the animals were residing; therefore, weighing was usually not performed more often than once per year. What's more, white rhinos never suffered loss of condition, meaning that weight was not so important source of information as with black rhinos. A total of 69 weight-related figures were obtained, including 11 in males and 58 in females.

In addition, adults of the southern subspecies were measured with the following findings: Frankie, weighing 2,095 kg, measured 171 cm at withers (1995), Sanni's weight was 1,990 kg, while measuring 150 cm at withers (1995), and the weight and withers height of Doran, a four years and four months old male, was 1,552 kg and 149 cm, respectively (1995).

The height at withers in the white rhino is 171-183 cm as reported by ESTES (1990), 150-185 cm according to PENNY (1988), and 160 to 190 cm as mentioned by TRENSE (1989).

### Weight of adult animals

In total, 62 weight figures related to live adult animals were obtained; more specifically these were 5 males and 9 females, indicating that the weight of adult males varied from 1,460 to 2,345 kg, with the mean individual weight ranging from 1,460 to 2,212 kilograms. Similarly, the weight of adult females varied from 1,530 to 2,320 kg, while the mean weight of individual animals ranged from 1,624 to 2,203 kg, when the largest female was Nasi - the subspecific hybrid. Further details are summed up in the following tables, indicating the average weight of about 1,832 kg in males and 1,878 kg in females. An interesting fact is that visually some males are obviously larger than females, while in terms of weight there are no greater differences between the sexes (HOLECKOVA 1995).

The collected data can be compared with that from other zoos, using the ISIS figures (ARKS), which together with the Dvur Kralove data are shown in the following tables. The ARKS figures are comparable with those obtained at Dvur Kralove Zoo, with the mean male and female weight 1,986 kg and 2,012 kg, respectively. The lower weight figures observed in Dvur Kralove namely relate to the fact that the Dvur Kralove animals came mostly from the wild and the weight-related data were in part obtained in aged animals with rather worse condition. This in particular is the case of male Ben, who was weighed at the time of dying, when the male had extremely lost weight and was aged so that he could not stand up alone (HOLECKOVA 1995). The great variance is also determined by the fact that white rhinos held in captivity are much larger and heavier than those in the wild, even though the wild-born rhinos in question were in fact held in captivity from the young age, thus their size was under influence of the captive diet. ESTES (1990) reports the weight in males to range from 2,040 to 2,260 kg, and the mean weight in females 1,600 kg.



Three-month-old Fatu DK 9 with her mother Najin DK 7 (th)

### Weights of adult male white rhinos at Dvur Kralove Zoo prior to 31 December 2009

Male	StdBk #	Weight (kg; min-max)	Average (kg)	Numbers	Comments
Frankie S	127	1,860-2,095	1,975	3	21-27 years old
Saut N	373	1,572-1,850	1,711	2	17-30 years old
Sudan N	372	1,712-1,845	1,800	14	22-36 years old
Ben S	19	1,460	1,460	1	Year 39
Suni N	630	2,104-2,345	2,212	13	15-28 years old
<b>Total</b>	<b>5 animals</b>	<b>1,460-2,345</b>	<b>1,832</b>	<b>33</b>	
Kruger S	139	1,900	1,900	1	ARKS - Edinburgh, following death (35 years)
Ferdinand S	93	1,700-1,894	1,825	3	ARKS - Copenhagen, about 45 years old
Zulu S	90	1,950	1,950	1	ARKS - Coulange, year 25
Arthur S	355	2,000-2,190	2,117	8	ARKS - Woburn, 40-42 years old
Lee S	600	1,940-2,310	2,138	10	ARKS - Werribee, 13-23 years old
<b>Total ARKS</b>	<b>5 animals</b>	<b>1,700-2,310</b>	<b>1,986</b>	<b>23</b>	

## Weights of adult female white rhinos at Dvur Kralove Zoo prior to 31 December 2009

Female	Stdbk #	Weight (kg; min-max)	Average (kg)	Numbers	Comments
Edita S	113	1,750	1,750	1	Year 10
Sanni S	199	1,870-1,990	1,930	3	24-30 years old
Nesari N	377	1,530-2,066	1,718	8	23-37 years old
Nasima N	351	1,680	1,680	1	Year 27
Nola N	374	2,000	2,000	1	Year 15
Nasi NxS	476	2,028-2,320	2,203	3	17-30 years old
Nabire N	789	1,965-2,130	2,016	6	12-26 years old
Najin N	943	1,954-2,036	1,983	3	7-20 years old
Fatu N	1,305	1,615-1,628	1,624	3	9-10 years old
<b>Total</b>	<b>9 animals</b>	<b>1,530-2,320</b>	<b>1,878</b>	<b>29</b>	

### Birth weight

The weight at birth was obtained from the first young that died immediately after the birth (Fali DK 1) - this male weighed 58.5 kg. HALTENORTH et al. 1984 report the birth weight 80-90 kg, while PUSCHMANN (1989) provides a mean weight of a mere 30-40 kg. Beekse Bergen Safari Park recorded the birth weight of 68 kg in female Dounia (Stdbk #1203). In Whipsnade, the birth weight of 66, 65 and 72 kg was recorded in three males (Stdbk #869 and 810, plus a male born on 25 March 2008), while in a male Green (born 7 March 2008) they found the weight of 64 kg on day 5.

### Growth and weight gain

Weighing of young rhinos produced only partial data on weight gain during the growth period; these are presented in the tables below, indicating that the daily gain was 1.17 kg/day up to the age of 2 years and 3 months and subsequently kept on decreasing, even though in three animals, the daily gain from the birth up to reaching 4.5 to 5.5 years was about 0.75 kg, more specifically, it ranged from 0.73 (Fatu) through 0.82 (Doran) to 0.85 (Najin) kg per day.

Growth was recorded in an infant rhino male Stan (born on 2 November 2006) at Beekse Bergen Safari Park, where this animal weighed 62.5 kg on reaching month 1 and 118 kg when nearing to month 3, meaning that this rhino gained weight 55.5 kg in 110 days, which is mean daily gain 0.5 kg; this calf had apparent health problems at that time, as initially its weight was on the decrease.

The same safari park recorded growth in a young female Imke (Stdbk #1350, born on 17 December 2000); this rhino weighed 58 kg on day 6, reaching 66 kg as early as day 11, which makes weight gain of 1.6 kg/day.

According to ISIS data (ARKS), a 1 year and 5 months old female Zimba (Stdbk #803) at Marwell Zoo weighed 1,219 kg, with approximate daily gain of 2.25 kg/day.



Najin DK 7 and Fatu DK 9, 2000 (dh)



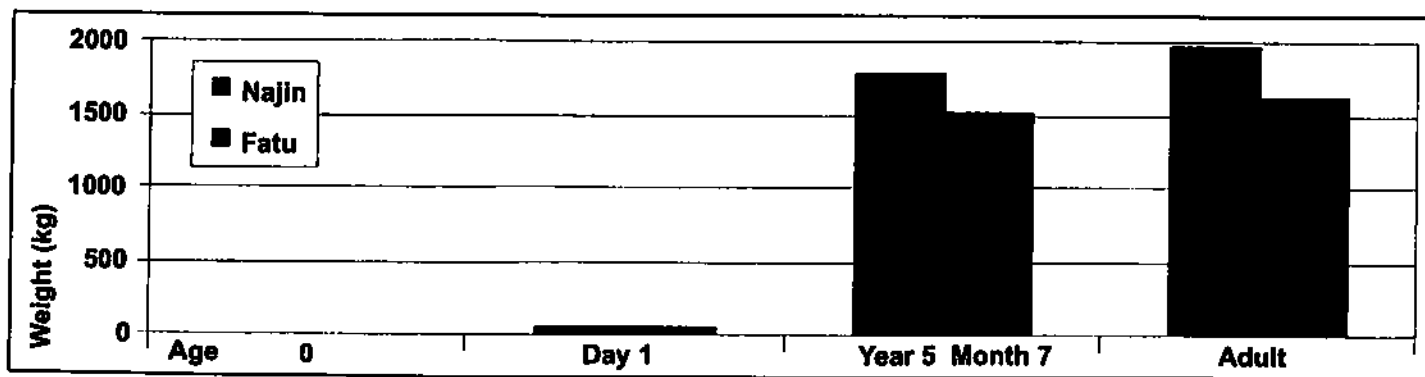
**Growth of male white rhinos at Dvur Kralove Zoo prior to 31 December 2009**

Age	Weight span	Mean	Comments
Birth weight	58.5	58.5	Fali
2 years and 3 months	1,020 kg		Doran
4 years and 4 months	1,552 kg		Doran
5 years and 4 months	1,656 kg		Doran
Adult	1,460-2,346 kg	1,832 kg	5 males, N = 14

**Weight gain in growing male white rhinos at Dvur Kralove Zoo prior to 31 December 2009**

Date	Age	Weight	Weight gain	Daily weight gain
<b>Fali DK 1 - M * 15 Aug 1976, Dvur Kralove</b>				
Birth weight	Day 1	58.5 kg		
<b>Doran - M * 13 Jan 1991, Usti nL.</b>				
Birth weight	Estimation	60 kg		
17 Apr 1993	2 years and 3 months	1,020 kg	+ 960 kg in 824 days	1.17 kg/day
10 May 1995	4 years and 4 months	1,552 kg	+ 532 kg in 753 days	0.71 kg/day
13 May 1996	5 years and 4 months	1,656 kg	+ 272 kg in 368 days	0.28 kg/day
<b>Najin DK 7 - F - * 11 Jun 1989, Dvur Kralove</b>				
Birth weight	Estimation	50 kg		
1 Mar 1995	5 years and 7 months	1,790 kg	+ 1,740 kg in 2058 days	0.85 kg/day
Adult	17-20 years	1,983 kg		
<b>Fatu DK 9 - F - * 29 Jun 2000, Dvur Kralove</b>				
Birth weight	Estimation	50 kg		
13 Jan 2006	5 years and 6.5 months	1,530 kg	+ 1,480 kg in 2023 days	0.73 kg/day
Adult	9-9.5 years	1,624 kg		

**Comparison of growth of northern white rhino females Najin and Fatu at Dvur Kralove Zoo**



### Maximum longevity

In Dvur Kralove, the highest age was achieved by the northern form of the white rhino male Ben (Stdbk #19, born 1950, Sudan), who was euthanised due to high age in 1990, when he was believed to be about 40 years. Saut (Stdbk #373, born 1972, Sudan) died at 34. The eldest female is Nesari (Stdbk #377, born 1972, Sudan), a female, who still lives and is 38, while the oldest living male is Sudan, 37 years old (Stdbk #372, born 1973 in Sudan).

From the originally Dvur Kralove's animals, Dan and Sasha held at Usti nad Labem Zoo survived about 42 years; another male Natal still lives at Ostrava Zoo, in 2009, this rhino was about 38 years old.

The ISIS data indicate that male Arthur (Stdbk #355, the father of Nasi DK 2) born in the wild around 1966 still lived at Woburn Zoo, England, in September 2008, when he was about 42 years old. A male Lumpy (Stdbk #353) reached the age about 26 years at Knowsley Safari Park, while female Maggie (Stdbk #352) lived about 41 years at the same location; both rhinos were born in the wild around 1966.

A male Balthazar/Seventy (Stdbk #76), who was born at Pretoria Zoo on 23 October 1969, survived 33 years and 9 months at Beekse Bergen Safari Park, while female Mira (Stdbk #223) born in the wild in 1969 lived 36 years at the park above.

From Copenhagen Zoo, they report a male Ferdinand (Stdbk #93), who achieved the age of over 45 years, provided the expected date of birth was correct (around 1962, Umfolozi NP). Other wild-caught individuals (male Kruger - Stdbk #139, male Gus - Stdbk #91 and female Mashobeni - Stdbk #20) lived about 36 years, while a male Zulu Stdbk #90 and female Ukhukho/Paddy Stdbk #71 reached 37.5 and near to 42 years, respectively. In Whipsnade, 31 and 32 years was the age achieved by other animals from the wild, a male Jonny (Stdbk #92) and female Karibu (Stdbk #226).

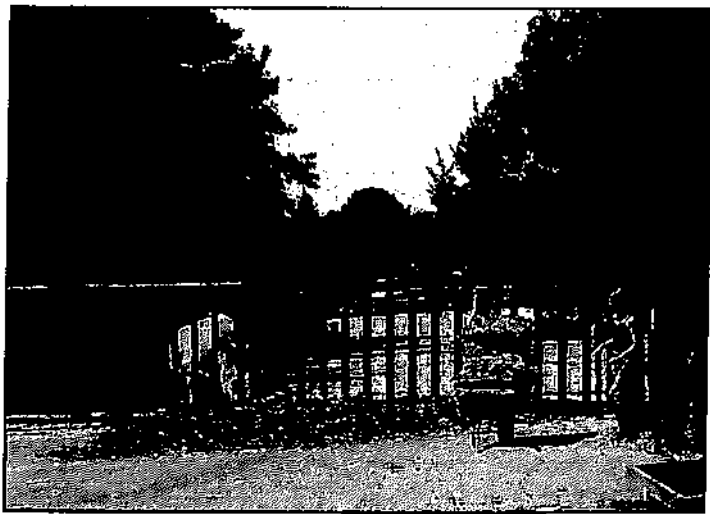
According to the International Studbook (GOLTENBOTH and OCHS 1997), there was a single female living in captivity within the range 56-58 years, three males within the 38-40 category and five males within the range from 36 to 38 years in 1996.

The first animal held in captivity, which was a southern female Zuluana (born 1946, Stdbk #56), who survived 41 years in Pretoria, SA, which was the same age that was reached by the northern male Ben (born 1950, Stdbk #19) (BLASZKIEWITZ 1991).

### Nutrition and feeding

Feeding in white rhinos is not problematic, although it appears that this species, unlike the black rhinoceros, can sometimes suffer from obesity and overfeeding (CLAUSS *et al.* 2005).

Throughout the history of the white rhino stock in Dvur Kralove, the rations underwent several changes that are presented in the table, which is documenting the efforts to stimulate breeding through changes in diet in the late 1980s, where it was rather concentrated in winter, while in April the percentage of pellets was reduced and a considerable portion of fresh green grass served.



Grass and hay form the basis of the diet. (dh)



A birthday 'cake' of Najin DK 7, Fatu DK 9 and Nabire DK 5 (th)

### Comparison of white rhino diets at Dvur Kralove Zoo

1986 diet (SPALA 1986)	1990 diet	Diet since 2001
Hay October to February: 19 kg March to May: 13 kg June to September: 9 kg Meadow stand June to September: 40 kg	Hay - <i>ad libitum</i> Summers: added grass and hay	Hay - <i>ad libitum</i> Summers: added grass and hay
ZOO I pellets October to February: 2 kg/animal March to May: 6 kg/animal	ZOO C pellets: 3 kg	ZOO C pellets: 3.5 kg
Crushed oats October to February: 3 kg/animal March to May: 0	Carrots - in winter: 5 kg / twice a week	Carrots: 2 kg in winter Fruits and vegetables: 4 kg
Carrots October to February: 3 kg March to May: 6 kg		Bread - 1 kg 1 bread roll
Dried alfalfa March to May: 4 kg		Oat germs - 1 kg
Skimmed milk March to May: 0.5 kg		Mineral licks (Aminovitan): 1 table spoon
Biosan (vitamins): 60 g/animal/day		Vitamix standard + H: 2 + 2 table spoons
		Fodder limestone: 1 table spoon
		Combisol 4: 1(4) ml/day Combisol A: 1 ml/month

The basis for the diet is high-quality grass hay supplemented with straw, and meadow grass in summer. This bulk feed as well as water is available to the animals *ad libitum*. In the winter, carrots are fed instead of fresh grass. In nursing females and growing calves, limestone and skimmed milk powder is added to the diet (PTACKOVA 2009). The current basic diet is shown in the following table. ZOO C pellets (manufacturer De Heus, Bucovice, CR) is produced according to the recipe developed directly in Dvur Kralove (SPALA 1986), with the nutritional levels as given in the following table.

### Basic diet of the white rhinoceros at Dvur Kralove Zoo in 2009 (PTACKOVA 2009)

Hay Grass	ZOO C pellets	Wheat bran	Bread	Aminovitan (Mineral licks)	NutriHorse Chon- dro
<i>Ad libitum</i>	2.8 kg	0.4 kg	0.3 kg	0.04 kg	0.07 kg

The diet includes the following supplements: C - Compositum 50 g/animal 3 times per week and vitamins A, B and E once per month.

**Nutritional values of the pelleted feeds for white rhinos at Dvur Kralove Zoo (PTACKOVA 2009)**

Pellets/contents	ZOO C. pellets
Nitrogen substances (N)	115.84 g/kg
Fat	29.49 g/kg
Fibre	111.71 g/kg
Vitamin A	40,849 IU/kg
Vitamin E	117.30 IU/kg
Calcium (Ca)	16.39 g/kg
Sodium (Na)	2.70 g/kg
Phosphorus (P)	12.07 g/kg

**Health issues**

Throughout the years, internal and external parasites were not an issue in the rhinos, except for the period immediately after the arrival from the wild, when the *Anoplocephala* genus of tapeworms was found at an occasional basis (VAHALA pers. comm.). Additionally, parasite borne ulcer-like skin lesions (filaria) were recorded shortly after arrival, but disappeared with time (VAHALA pers. comm.).

In the northern form, two cases of death as a result of shock occurred, the first of which followed upon painful rupture of pubic symphysis (Nuri), while the second was the death of female Nasima that had blocked in a restraint chute during a process of sampling. Nasima spontaneously aborted her last calf less than a year prior her death, when she had reached day 296 of pregnancy. This was preceded by prolapsed uterine, which unfortunately repeated despite the veterinary treatment. Generally, white rhinos did not almost suffer any health problems, except for overgrown hooves in females and mucus discharged from nostrils. On the other hand, the absent breeding in most of the females, who in fact lacked the cycle, was an issue. Therefore, the veterinary management focused in particular on efforts to make the non-breeding females reproduce, which comprised gynaecological examinations including hymen perforation, hormonal stimulation and several assisted insemination attempts. In the non-breeding females, namely Nasi, Nesari and Nabire, ovarial (cysts) and uterine (tumours) disorders appeared as a result of failed function of reproduction organs.

In the southern form, there were two cases of death of young rhinos not long after their import from Africa as a result of transport (imported female #5 and male #8). In addition, a newborn calf died in a single event, again as a result of trauma, as female Faith gave birth without being expected to do so in the company of other two females.

The reasons for death are outlined in the table below (VAHALA - post mortem reports).



Hoof trimming carried out by Dr J Vahala (dh)



Young Najin DK 7, 3 May 1994 (lh)

### Causes of deaths in the white rhinoceros at Dvur Kralove Zoo prior to 31 December 2009

(N = northern form, S = southern form)

No.	Name	Sex	Total died	Age	Cause of death
5/5/DK/0	- S	F	28 Sep 1970	3 years	Died on day 21 following the transport - possibly pneumonia
8/8/DK/0	Faru S	M	12 Jun 1972	1.5 years	Died on day 12 following the transport
21/0/DK/1	Fali S	M	15 Aug 1976	At birth	Trauma - ruptured lung when born in the group of three females, weighed 58.5 kg
19/19/DK/0	Nun N	F	4 Jan 1982	9 years	Collapsed when slipped on ice, shocked following a painful pelvis injury
29/23/DK/0	Ben N	M	25 Jun 1990	40 years	Euthanised for age, unable to stand up; weight 1,460 kg
33/0/DK/8	- N	F	18 Jul 1991	Abortion	Spontaneous abortion of Nasima on pregnancy day 286, weight 17.2 kg
22/21/DK/0	Nasima N	F	28 Jun 1992	27 years	Collapsed when fell in the chute after her horn has blocked, weight 1,680 kg
15/15/DK/0	Saut N	M	25 Feb 2006	34 years	Heart failure
24/0/DK/2	Nasi NxS	F	20 Jun 2007	30 years	Euthanised for tumour-like disease of uterus

### Exports of white rhinoceroses

Throughout the white rhino collection history, all individuals of the southern form kept in Dvur Kralove were exported, as the southern white stock was discontinued. In a single case, a male left after having passed the quarantine period provided by Dvur Kralove for Liberec Zoo. Any later departures related to the efforts of making the northern form reproduce, when first 3 (1.2) animals left for San Diego WAP, California, in 1989. A southern white rhino pair was imported to Dvur Kralove and added to the remaining northern animals to stimulate the breeding behaviour; however, as these rhinos were too old for stimulating, which especially applied to the female, they left in 1996. In the same year, Doran, a southern white male placed in Dvur Kralove only as part of cooperation between two Czech zoos breeding the white rhino, left as well.

Within the Last Chance to Survive project, through which Dvur Kralove Zoo has attempted to save the northern form, the last remaining 4 (2.2) northern white rhinos with breeding potential held in captivity were moved to the Ol Pejeta Conservancy, Kenya. In total, 25 (9.16) white rhinos left Dvur Kralove, including 7 (3.4) animals of the northern form.

### Overview of white rhinos exported from Dvur Kralove Zoo prior to 31 December 2009 (M - male, F - female)

No.	Sex	Name	Std/bk #	Departure	Born	Arrival	Comments
1	F	Dinah S	208	30 Oct 1994, Ostrava	1970, Umfolozi, SA	31 May 1972, Umfolozi, SA	† Ostrava
2	M	Natal S	371	30 Oct 1994, Ostrava	1971, Umfolozi, SA	9 Jul 1973, Umfolozi, SA	Still alive
3	F	Uzima S	910	12 Nov 1974, Demmer	19??, Umfolozi, SA	9 Jul 1973, Umfolozi, SA	
4	F	Edita S	113	3 Jun 1976 Liberec	1966, Umfolozi, SA	23 Jun 1970, Umfolozi, SA	† Liberec
5	M	Rushden S	279	19 Oct 1976, Liberec	15 Oct 1974, Whip-snade, England	7 Sep 1976, Gelsenkirchen, Germany	† Liberec
6	F	Vanda S	115	27 Apr 1979, Gelsenkirchen, Germany	1967, Umfolozi, SA	15 Oct 1970, Umfolozi, SA	Southern form stock discontinued
7	M	Joe S	110	12 Jul 1979, Lesna	1965, Umfolozi, SA	2 Jun 1970, Umfolozi, SA	Southern form stock discontinued
8	F	Zuzi S	112	12 Jul 1979 Lesna	1966, Umfolozi, SA	2 Jun 1970, Umfolozi, SA	Southern form stock discontinued

No.	Sex	Name	Stdbk #	Departure	Born	Arrival	Comments
9	F	Fatty DK 2 S	530	26 Jul 1979 Veszprem, Hungary	4 Apr 1978 Dvur Kralove	Reared	Southern form stock discontinued
10	F	Tessa S	210	1 Oct 1980 Wroclaw, Poland	1970, Umfolozi, SA	31 May 1970, Umfolozi, SA	Southern form stock discontinued
11	F	Faith S	211	4 Nov 1980 Katowice, Poland	1970, Umfolozi, SA	31 May 1970, Umfolozi, SA	Southern form stock discontinued
12	F	Smudla S	307	3 Oct 1980 Wroclaw, Poland	1973, SA	5 Oct 1977 Demmer, Langato	Southern form stock discontinued
13	M	Teny DK 4 S	531	29 Oct 1980 Wroclaw, Poland	16 Dec 1978, Dvur Kralove	Reared	Southern form stock discontinued
14	F	Sasha S	114	19 Nov 1980, Usti n/L	1966, Umfolozi, SA	23 Jun 1970, Umfolozi, SA	Southern form stock discontinued
15	F	Zamba S	209	19 Nov 1980, Usti n/L	1970, Umfolozi, SA	31 May 1970, Umfolozi, SA	Southern form stock discontinued
16	M	Dan S	111	4 Dec 1980, Usti n/L	1966, Umfolozi, SA	15 Oct 1970, Umfolozi, SA	Southern form stock discontinued
17	M	Saut N	373	14 Oct 1989 San Diego WAP USA	1972, Sudan	19 Sep 1975, Sudan	Loaned to the USA as part of efforts to make the northern subspecies reproduce
18	F	Nola N	374	14 Oct 1989 San Diego WAP USA	1974, Sudan	19 Sep 1975, Sudan	Loaned to the USA as part of efforts to make the northern subspecies reproduce
19	F	Nadi N	376	14 Oct 1989 San Diego WAP USA	1972, Sudan	19 Sep 1975, Sudan	Loaned to the USA as part of efforts to make the northern subspecies reproduce
20	M	Doran S	970	25 Jun 1996 Belo Horizonte, Brazil	13 Jan 1980 Usti n/L	21 Apr 1980, Usti n/L	Loaned due to space issues in Usti n/L
21	M	Frankie S	127	9 Jul 1996 Aywaille, Belgium	14 Jan 1969 Pretoria, SA	24 Aug 1990 Cologne, Germany	Loaned as part of efforts to make the northern subspecies reproduce
22	F	Sanni S	199	9 Jul 1996 Aywaille, Belgium	1966 Looskopdam, SA	24 Aug 1990 Cologne, Germany	Loaned as part of efforts to make the northern subspecies reproduce
23	M	Sudan N	372	19 Dec 2009, Ol Pejeta Conservancy, Kenya	1973, Sudan	19 Sep 1975, Sudan	Last Chance to Survive Project
24	M	Suni N	630	19 Dec 2009, Ol Pejeta Conservancy, Kenya	8 Jun 1989 Dvur Kralove	Reared	Last Chance to Survive Project
25	F	Najin N	943	19 Dec 2009, Ol Pejeta Conservancy, Kenya	11 Jul 1989 Dvur Kralove	Reared	Last Chance to Survive Project
26	F	Fatu N	1305	19 Dec 2009, Ol Pejeta Conservancy, Kenya	29 Jun 2000 Dvur Kralove	Reared	Last Chance to Survive Project

**In total, 26 (10.16) individuals were exported, of which 4 (2.2) were returned to the wild in Africa.**

N = northern form, S = southern form

## Summary

Dvur Kralove Zoo has held both forms of the white rhinoceros, with 14 (3.11) southern whites and 6 (2.4) northern white rhinos imported from the wild from 1970 to 1973 and 1977, respectively. From 1976 to 1978, 3 (2.1) calves of the southern form were born; however, the southern stock was discontinued in 1980 to provide more space for the northern subspecies. Throughout the history of the stock, 6 (1.5) northern white rhinos were born, of which the first calf was a subspecific hybrid, as its mother was mated by a southern white male at Knowsley Zoo, England. Out of all 9 (3.6) white rhino infants, 7 (1.5) were successfully reared. Dvur Kralove Zoo, in an attempt to make the northern subspecies reproduce, sent first their 3 (1.2) rhinos only 14-15 years old on the basis of international discussions to the Wild Animal Park San Diego, USA, where they however were not successful in making the animals breed. As the most recent northern white rhino was born in 2000, though that animal was an F2 generation in captivity, and females held in zoological parks are known to fail cycling very frequently, the 4 (2.2) last remaining fertile captive animals were sent to the Ol Pejeta Conservancy, Kenya within the Last Chance to Survive project in December 2009; that is why Dvur Kralove Zoo currently holds only 2 non-breeding females of the northern subspecies. More details about the white rhino stock throughout almost 40 years are compiled in the following table.

**Numbers of white rhinos at Dvur Kralove Zoo in the period from 1970 to 2009 (1.0 - male, 0.1 - female)**

YEAR	Status as per 1 Jan	Arrival	Departure	Total born	Death	Status as per 31 Dec
1970	0	6 (2.4) S	-	-	-	6 (2.4)
1971	6 (2.4)	-	-	-	-	6 (2.4)
1972	6 (2.4)	5 (1.4) S	-	-	1 (1.0) S	10 (2.8)
1973	10 (2.8)	2 (1.1) S	-	-	-	12 (3.9)
1974	12 (3.9)	-	3 (1.2) S	-	-	9 (2.7)
1975	9 (2.7)	6 (2.4) N	-	-	-	15 (4.11)
1976	15 (4.11)	-	1 (0.1) S	1 (1.0) S	1 (1.0) S	14 (4.10)
1977	14 (4.10)	2 (0.2) N+S	-	1 (0.1) N x S	-	17 (4.13)
1978	17 (4.13)	-	-	2 (1.1) S	-	19 (5.14)
1979	19 (5.14)	-	4 (1.3) S	-	-	15 (4.11)
1980	15 (4.11)	-	7 (2.5) S	1 (1.0) N	-	9 (3.6)
1981	9 (3.6)	-	-	-	-	9 (3.6)
1982	9 (3.6)	-	-	-	1 (0.1) N	8 (3.5)
1983	8 (3.5)	-	-	1 (0.1) N	-	9 (3.6)
1984	9 (3.6)	-	-	-	-	9 (3.6)
1985	9 (3.6)	-	-	-	-	9 (3.6)
1986	9 (3.6)	1 (1.0) N	-	-	-	10 (4.6)
1987	10 (4.6)	-	-	-	-	10 (4.6)
1988	10 (4.6)	-	-	-	-	10 (4.6)



YEAR	Status as per 1 Jan	Arrival	Departure	Total born	Death	Status as per 31 Dec
1989	10 (4.6)	-	3 (1.2) N	1 (0.1) N	-	8 (3.5)
1990	8 (3.5)	2 (1.1) S			1 (1.0) N	9 (3.6)
1991	9 (3.6)	-		1 (0.1) N	1 (0.1) N	9 (3.6)
1992	9 (3.6)	-		-	1 (0.1) N	8 (3.5)
1993	8 (3.5)	1 (1.0) S		-	-	9 (4.5)
1994	9 (4.5)	-		-	-	9 (4.5)
1995	9 (4.5)	-		-	-	9 (4.5)
1996	9 (4.5)	-	3 (2.1) S		-	6 (2.4)
1997	6 (2.4)	-			-	6 (2.4)
1998	6 (2.4)	1 (1.0) N			-	7 (3.4)
1999	7 (3.4)	-			-	7 (3.4)
2000	7 (3.4)	-		1 (0.1) N	-	8 (3.5)
2001	8 (3.5)	-		-	-	8 (3.5)
2002	8 (3.5)	-		-	-	8 (3.5)
2003	8 (3.5)	-		-	-	8 (3.5)
2004	8 (3.5)	-		-	-	8 (3.5)
2005	8 (3.5)	-		-	-	8 (3.5)
2006	8 (3.5)	-		-	1 (1.0) N	7 (2.5)
2007	7 (2.5)	-		-	1 (0.1) N x S	6 (2.4)
2008	6 (2.4)	-		-	-	6 (2.4)
2009	6 (2.4)	-	4 (2.2) N	-	-	2 (0.2)
<b>Total</b>	-	<b>26 (10.16)</b>	<b>25 (9.16)</b>	<b>9 (3.6)</b>	<b>8 (4.4)</b>	-
<b>Total southern form</b>	-	<b>17 (6.11)</b>	<b>16 (6.12)</b>	<b>3 (2.1)</b>	<b>2 (2.0)</b>	-
<b>Total northern form</b>	-	<b>8 (4.5)</b>	<b>7 (3.4)</b>	<b>5 (1.4) + 1 (0.1) N x S</b>	<b>5 (2.3) + 1 (0.1) N x S</b>	-
<b>Total hybrids</b>	-	-	-	<b>1 (0.1)</b>	<b>1 (0.1)</b>	-

N = northern form, S = southern form

The overview on page 250 - 252 contains basic historical information about the individual white rhinos that were a Dvur Kralove Zoo property.

## BASIC GUIDELINES FOR REARING THE WHITE RHINOCEROS

On the basis of almost 40 years of experience, principles of breeding and managing in Dvur Kralove to create optimal conditions for the white rhinos can be summarised as follows:

1. **Nutrition is not very complicated**; the diet consists of high-quality hay, grass, fruits, vegetables and pellets. Animals should be weighed on a periodical basis to ensure inspection.
2. **If kept in a group situation, sufficient space is required, even though introducing to males is usually nothing dramatic.** A group of rhinos can be released into the outside enclosure daily except for extreme outdoor temperatures with potential inclusion of a male over unlimited periods of time.
3. **Monitoring the females' cycling and pregnancy using faeces is very important**, as it will allow for early separation of the female prior birth.
4. **When the female is about to give birth, timely isolation into a separate box is necessary**, where a temporary barrier between the fence openings above the ground is required to prevent the calf to escape from the box. **Monitoring the process of birth and the behaviour of the female after the birth using CCTV with a recording feature is the best choice**; this will allow for evaluation of the behaviour of mother and calf, as well as monitoring of the nursing process. For a better stability of the calf when trying to stand up after the birth, sprinkling little sand around the box is advisable, which depends on the slipperiness of the wet floor.
5. Breeding is the biggest issue, as females tend to fail cycling. Keeping in a pair situation will not result in breeding, and even holding the animals in groups is not sufficient to make the females cycling. Inducing oestrus seems to need changes in social links, for instance by exchanging the male or separating the female with the calf following the birth and subsequent return of the female into the group. Permanent keeping the mother with her subadult daughter has appeared to prevent the mother cycling.
6. **Having good keepers is fundamental.**

### History of white rhino keeping at Dvur Kralove Zoo prior to 31 December 2009

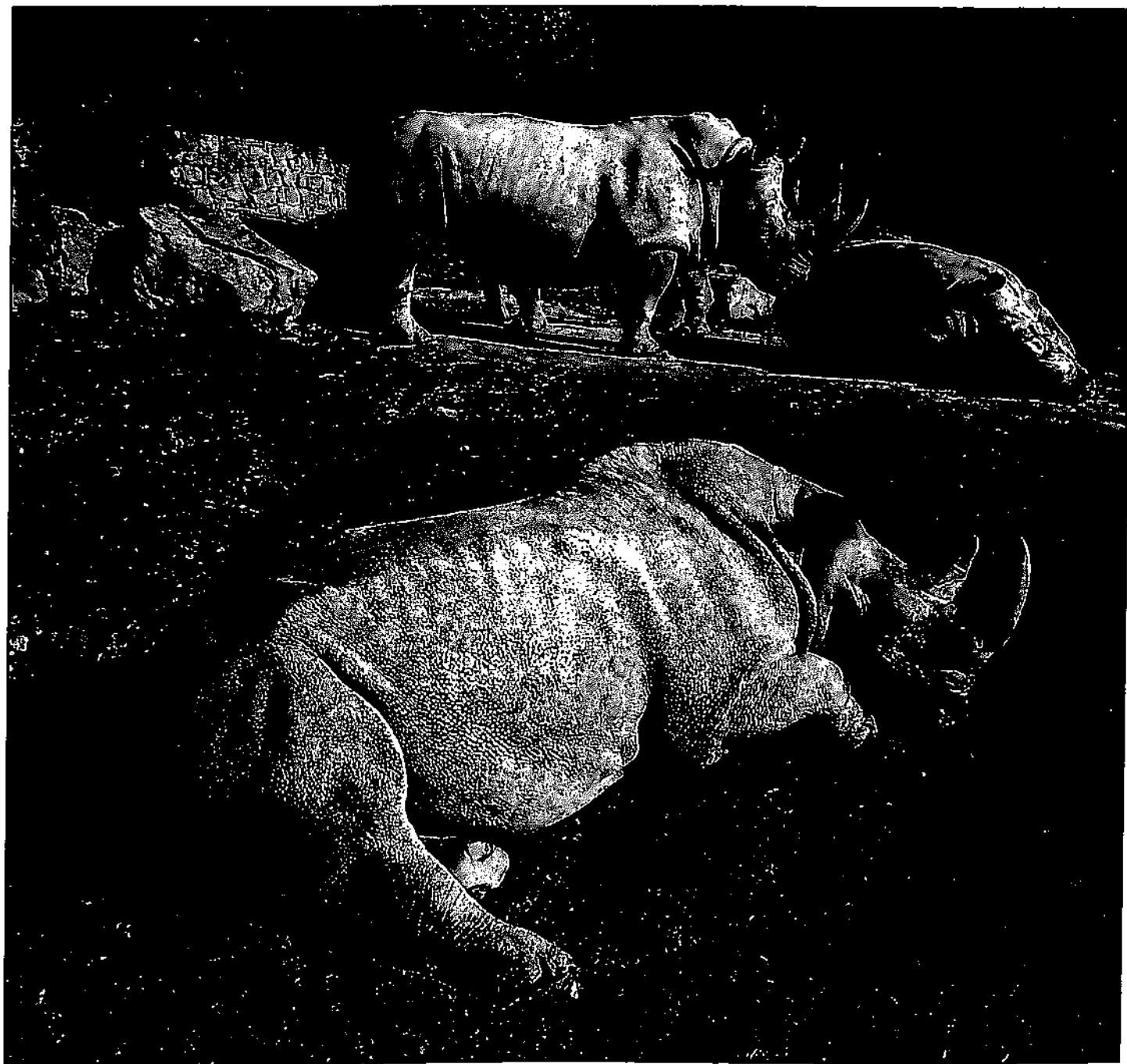
(M - male, F - female; blue: northern form animals)

No. Name	Sex	Stabk # ARKS	Born	Arrival in DK Parents	Departure from DK	Died	Comments
1/1/DK/0 Joe	M	110 117004	1965 Umfoloji NP	2 Jun 1970 Wild-caught, SA	12 Jul 1979 Lesna		
2/2/DK/0 Zuzi	F	112 117006	1966 Umfoloji NP	2 Jun 1970 Wild-caught, SA	16 Jul 1979 Lesna		
3/3/DK/0 Edita	F	113 117007	1966 Umfoloji NP	23 Jun 1970 Wild-caught, SA	3 Jun 1976 Liberec		
4/4/DK/0 Sasha	F	114 117008	1967 Umfoloji NP	23 Jun 1970 Wild-caught, SA	19 Nov 1980 Usti n/L	† 21 Mar 2008 Usti n/L	Euthanised
5/5/DK/0 —	F	1158 117021	15 Oct 1967 Umfoloji NP	7 Sep 1970 Soest, Brink	-	† 28 Sep 1970 Dvur Kralove	Died in the quarantine period Probably pneumonia
6/6/DK/0 Dan	M	111 117005	1970 Umfoloji NP	15 Oct 1970 Wild-caught, SA	4 Dec 1980 Usti n/L	† 28 Mar 2008 Usti n/L	1st breeding male High age
7/7/DK/0 Vanda	F	115 117009	1967 Umfoloji NP	15 Oct 1970 Wild-caught, SA	27 Apr 1979 Ruhe		

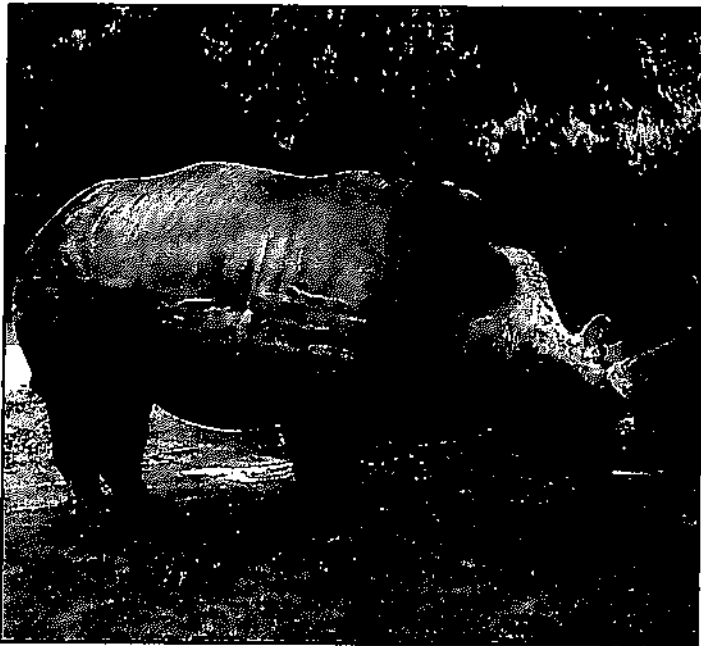
No. Name	Sex	Stdbk # ARKS	Born	Arrival in DK Parents	Departure from DK	Died	Comments
8/8/DK/0 Faru	M	892 117020	1971 Umfoloji NP	31 May 1972 Wild-caught, SA	-	12 Jun 1972 Dvur Kralove	Died in the quarantine period, trauma
9/9/DK/0 Dinah	F	208 117010	1970 Umfoloji NP	31 May 1972 Wild-caught, SA	30 Oct 1994 Os- trava	† 7 Mar 2008 Ostrava	
10/10/DK/0 Zamba	F	209 117011	1970 Umfoloji NP	31 May 1972 Wild-caught, SA	19 Nov 1980 Usti n/L		Still alive
11/11/DK/0 Tessa	F	210 117012	1970 Umfoloji NP	31 May 1972 Wild-caught, SA	1 Oct 1980 Wroclaw, Poland		3rd breeding female
12/12/DK/0 Faith	F	211 117013	1970 Umfoloji NP	31 May 1972 Wild-caught, SA	29 Oct 1980 Kalo- wice, Poland		1st breeding female
13/13/DK/0 Natal	M	371 117016	1971 Umfoloji NP	9 Jul 1973 Wild-caught, SA	30 Oct 1994 Os- trava		Son of Uzima Still alive
14/14/DK/0 Uzima	F	910 117019	1965 Umfoloji NP	9 Jul 1973 Wild-caught, SA	12 Nov 1974 Demmer		Mother of Natal
15/15/DK/0 Saut	M	373 059002	9.1972 Sudan	19 Sep 1975 Wild-caught, Sudan 15 Jul 1998 San Diego WAP (USA)	14 Oct 1989 San Diego WAP (USA)	14 Aug 2006 Dvur Kralove	2. 2nd breeding male Loaned to the USA - returned
16/16/DK/0 Sudan	M	372 059001	1973 Sudan	19 Sep 1975 Wild-caught, Sudan	19 Dec 2009 Ol'Pobjeta, Kenya		3rd breeding male Loaned to Kenya
17/17/DK/0 Nadi	F	376 059005	1972 Sudan	19 Sep 1975 Wild-caught, Sudan	14 Oct 1989 San Diego WAP (USA)		Breeding loan Returned from loan
18/18/DK/0 Nesari	F	377 059006	1972 Sudan	19 Sep 1975 Wild-caught, Sudan			
19/19/DK/0 Nuri	F	375 059004	1973 Sudan	19 Sep 1975 Wild-caught, Sudan		4 Jan 1982 Dvur Kralove	Trauma, collapsed, shock - fell on ice
20/20/DK/0 Nola	F	307 059003	1974 Sudan	19 Sep 1975 Wild-caught, Sudan	14 Oct 1989 San Diego WAP (USA)		
21/0/DK/1 Fali DK 1	M	??? 117014	15 Aug 1976 Dvur Kralove	Reared Faith/Dan		15 Aug 1976 Dvur Kralove	Trauma - ruptured lung, born inside a group
22/21/DK/0 Nasima	F	351 059007	1985 Uganda	27 Aug 1977 Knowsley, UK		28 Jun 1992 Dvur Kralove	Name in the UK: Twink 3rd breeding female Collapse - shock

No. Name	Sex	Stdbk # ARKS	Born	Arrival in DK Parents	Departure from DK	Died	Comments
23/22/DK/0 Smudla	F	307 117015	1973 Umfoloji NP	5 Oct 1977 Langato	3 Oct 1980 Wroclaw, Poland		
24/0/DK/2 Nasi DK 2	F	476 059008	11 Nov 1977 Dvur Kralove	Reared Nasima/southern form	-	20 Jun 2007 Dvur Kralove	Tumour in uterus
25/0/DK/3 Fatty DK 3	F	530 117017	4 Apr 1978 Dvur Kralove	Reared Faith/Dan	26 Jul 1979 Veszprem, Hungary		
26/0/DK/4 Teny DK 4	M	531 117018	16 Dec 1978 Dvur Kralove	Reared Tessa/Dan	1 Oct 1980 Wroclaw, Poland		
27/0/DK/5 Suni DK 5	M	630 059009	8 Jun 1980 Dvur Kralove	Reared Nasima/Saut	19 Dec 2009 Ol Pejeta, Kenya		Loaned to Kenya
28/0/DK/6 Nabire DK 6	F	789 059010	15 Nov 1983 Dvur Kralove	Reared Nasima/Sudan	-		
29/23/DK/0 Ben	M	019 059011	1950 Sudan	27 Aug 1986 London Zoo, UK	-	25 Jun 1990 Dvur Kralove	Euthanized due to high age
30/0/DK/7 Najin DK 7	F	943 059012	11 Jul 1989 Dvur Kralove	Reared Nasima/Sudan	19 Dec 2009 Ol Pejeta, Kenya		4th breeding female Loaned to Kenya
31/24/DK/0 Frankie	M	127 117001	14 Jul 1968 Looskopdam, SA	24 Aug 1990 Cologne, Germany	9 Jul 1996 Aywaille, Belgium		Loan as part of efforts to make the NWR breed
32/25/DK/0 Sanni	F	199 117002	18 May 1966 Umfoloji, SA	24 Aug 1990 Cologne, Germany	9 Jul 1996 Aywaille, Belgium		Loan as part of efforts to make the NWR breed
33/0/DK/8 —	F	1122 059013	18 Jul 1991 Dvur Kralove	Reared Nasima/Sudan		18 Jul 1991 Dvur Kralove	Abort - placed in National Museum Prague
34/26/DK/0 Doran	M	970 117003	13 Jan 1991 Usti n/L	16 Apr 1993 Usti n/L	25 Jun 1996 Belo Horizonte, Brazil		Loaned as part of assistance
35/0/DK/9 Fatu DK 9	F	1305 059014	29 Jun 2000 Dvur Kralove	Reared Najin/Saut	19 Dec 2009 Ol Pejeta, Kenya		F2 - the Baby of the Millennium Loaned to Kenya

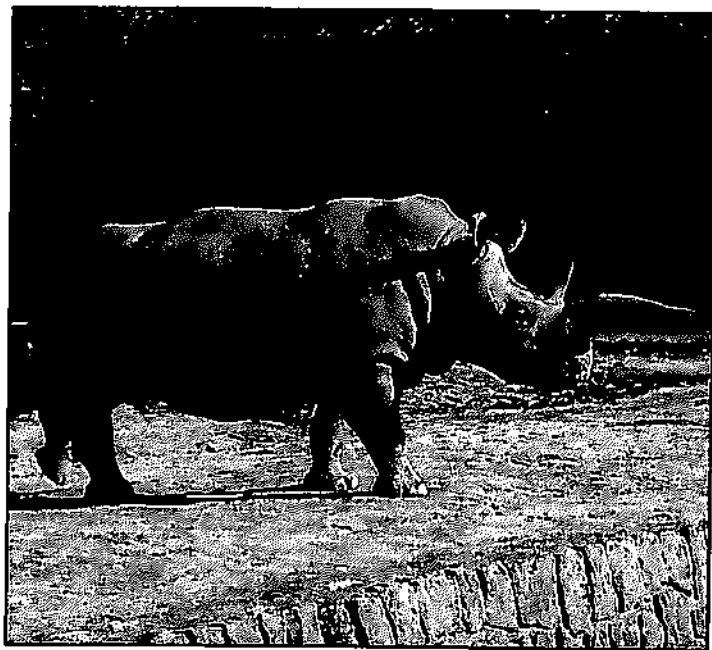
Explanation for figures: 13/13/DK/0: 13 - Historical (time) serial number of individual at Dvur Kralove Zoo  
13 - Historical serial number of import to Dvur Kralove Zoo  
DK - Dvur Kralove Zoo symbol  
0 - Historical serial number of birth at Dvur Kralove Zoo



*Northern white rhinos in the outdoor enclosure, 2002 (mp)*



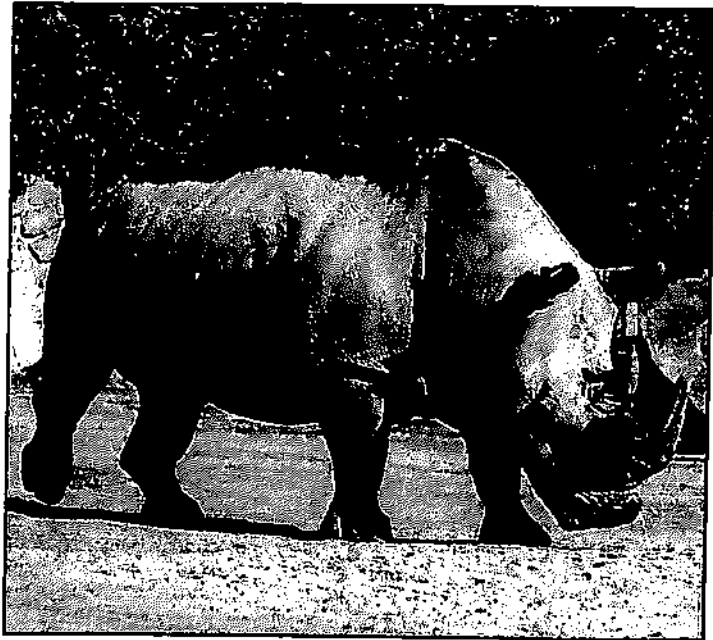
*Young Najin DK 7 (dh)*



*The modified horn in adult Najin DK 7 (dh)*



*Sudan (left), Nasi DK 2 and Nabire DK 6 (far right) being united (dh)*



*Suni DK 5 was the heaviest white rhino, with as much as 2.4 t measured. (dh)*

Northern white rhinos in winter



*Najin DK 7 and Fatu DK 9 outdoors, 2001 (dh)*



*Suni DK 5 in the snow (lh)*



*Young Najin DK 7 ranging in the snow (dh)*