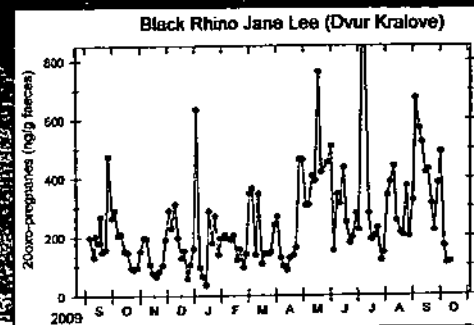
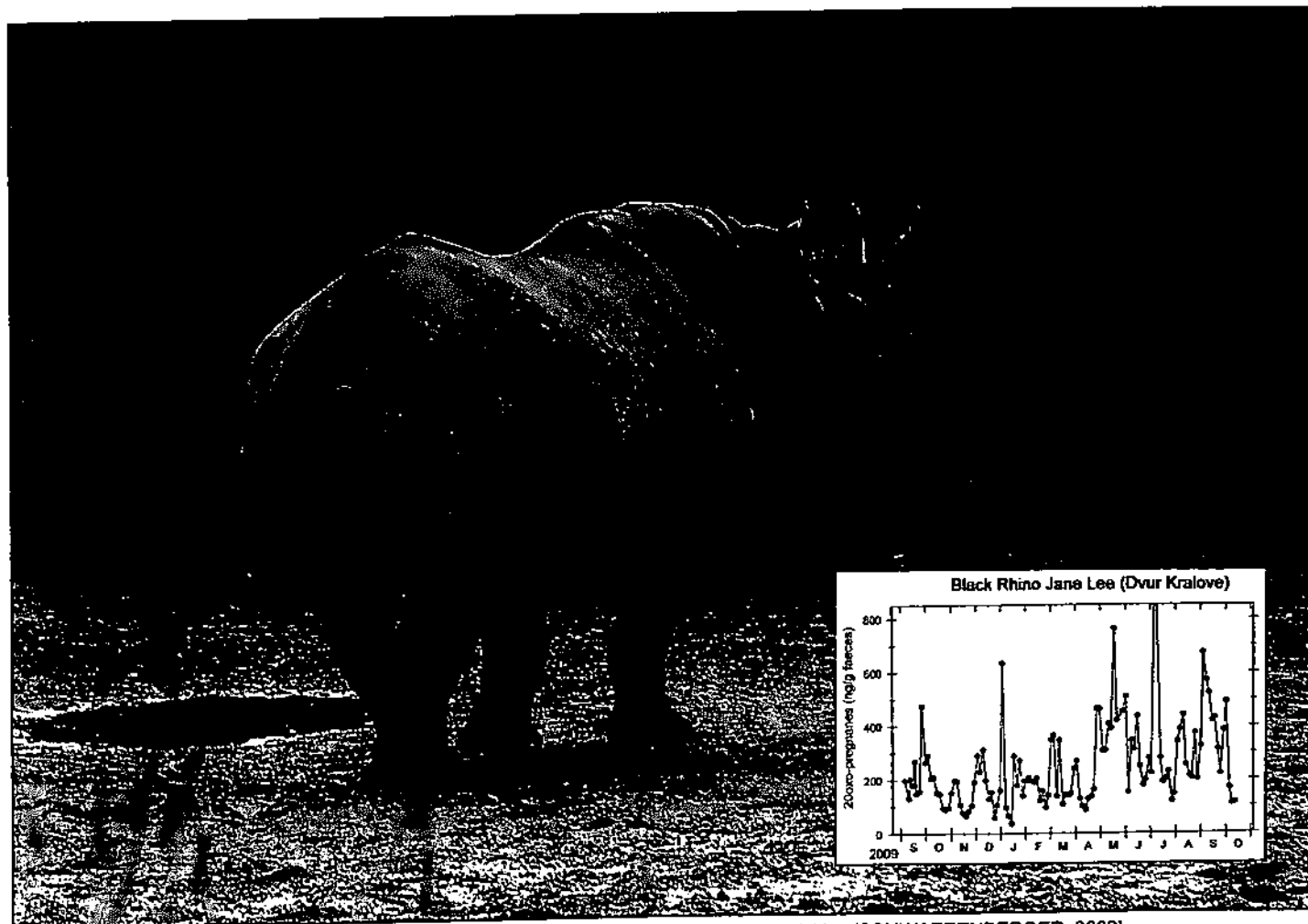


Jane Lee DK 22 - born 24 Jan 1998, Dvur Kralove; Stdbk #689

No.	Sex	Name	Dam	Sire	Pregnancy date	Birth date	Pregnancy time	House ID; comments
1	M	— DK 32	Jane Lee	Mweru	25 Aug 2006	22 Sep 2007	393 days	House 3; abortion on day 393, 29 kg

Jane Lee was the only female in the trio (Jane Lee, Jola and Musso), who was able of being coupled with Mweru. The process of coupling lasted 2 years and Jane Lee was mated more than one year before she got pregnant at the age of 8.5 years. Sadly, she gave premature stillbirth about 1.5 months before the due date of birth. Since then this female repeatedly mated with Mweru, but never got pregnant. In July 2009, Jane Lee was examined and found to have her reproductive organs in good order; it was hypothesized by IZW Berlin that problems could have been caused by some kind of an allergic reaction to male's semen in connection with premature birth. It was therefore decided that if the female fails to get pregnant with Mweru in 2009, she would be coupled with another male.

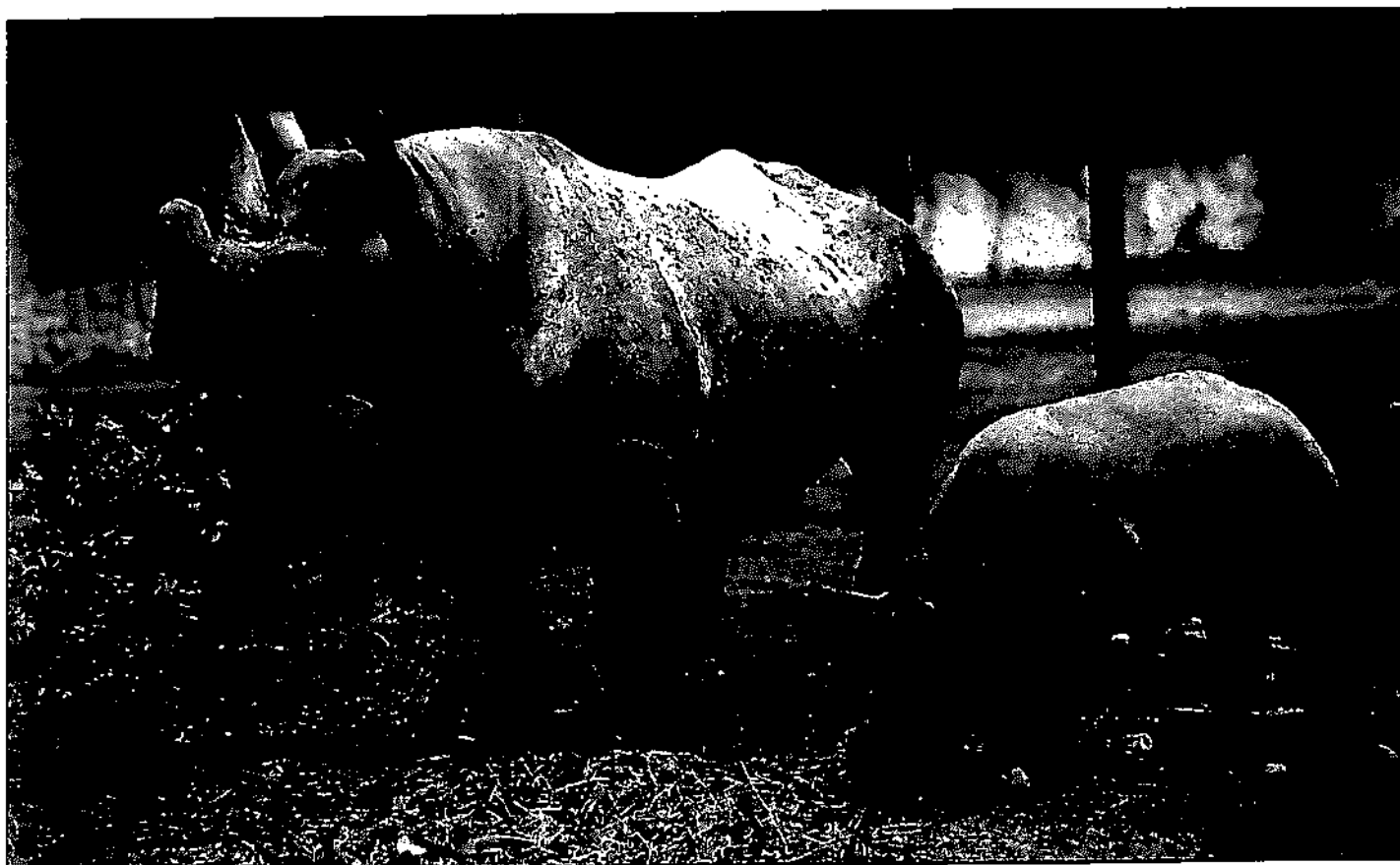


Jane Lee DK 22 on 14 November 2006 (dh) plus a chart showing the female's hormonal activities (SCHWARZENBERGER, 2009)

Mating and births incl. abortions in the black rhino at Dvur Kralove Zoo prior to 31 December 2009 (M - male, F - female)

DK	Sex	Name	Conceived	Birth	Dam	Sire	Birth location / comments
1	F	Elvira DK 1	20 Jul 1976	2 Oct 1977	Elsa	Ken	House 2
2	F	Sali DK 2	15 Apr 1977	5 Jul 1978	Sabi	Ken	House 2
3	M	Jimm DK 3	6 Dec 1977	18 Mar 1979	Jimmi	King	Wintering facility IV
4	M	Eli DK 4	20 Feb 1983	15 May 1984	Elvira	Isis	House 1
5	F	Jessi DK 5	4 Aug 1983	8 Dec 1984	Jimmi	Isis	House 1
6	M	Sado DK 6	21 Apr 1985	26 Aug 1986	Sali	Isis	House 2
7	M	Jos DK 7	13 Feb 1988	21 May 1989	Jimmi	Isis	House 2 / 28 kg
8	F	Sany DK 8	28 Jun 1988	1 Oct 1989	Sali	Isis	House 1
9	F	Eimi DK 9	29 May 1989	24 Aug 1990	Elvira	Isis	House 1
10	M	Jacob DK 10	8 Apr 1990	23 Jun 1991	Jessi	Eli	New house
11	M	Jasper DK 11	11 Jun 1990	13 Sep 1991	Jimmi	Isis	House 1
12	F	Sara DK 12	22 Nov 1990	24 Feb 1992	Sali	Jimm	House 1
13	F	Etna DK 13	21 Sep 1991	8 Dec 1992	Elvira	Jimm	House 1
14	F	Jaga DK 14	1 Sep 1991	14 Dec 1992	Jarca	Jimm	House 1, 26 kg on day 2
15	F	— DK 15	8 Feb 1993	11 Apr 1994	Jimmi	Mabu	New house, stillborn, 24 kg
16	M	Sauron DK 16	16 Jul 1993	26 Oct 1994	Sali	Cody	House 1, 48 kg on day 3
17	F	Jiddah DK 17	17 Aug 1993	15 Nov 1994	Jessi	Mabu	New house, 37 kg
18	-	—	3 Jun 1995	21 Jun 1995	Elvira	Cody	House 1, aborted on day 18
19	M	Jonas DK 18	2 Sep 1994	4 Dec 1995	Jarca	Cody	House 1, died while being hand-reared
20	F	Elba DK 19	23 May 1995	5 Aug 1996	Eimi	Cody	House 1
21	F	Musso DK 20	25 May 1996	20 Aug 1997	Sali	Jimm	House 1
22	F	Jola DK 21	1 Jul 1996	25 Oct 1997	Jessi	Mabu	New house
23	F	Jane Lee DK 22	4 Oct 1996 (?)	24 Jan 1998	Jimmi	Isis	New house
24	F	Salome DK 23	13 Oct 1998	25 Jan 2000	Sali	Jimm	House 1
25	M	Jeremy DK 24	16 Sep 1999	21 Dec 2000	Jessi	Jimm	House 1
26	F	— DK 25	10 Jun 2001	24 Aug 2002	Eimi	Sauron	House 1, stillborn, 33 kg
27	F	Ema-Elsa DK 26	4 Aug 2001	2 Nov 2002	Elba	Jimm	House 1
28	F	Deborah DK 27	5 Jun 2003	11 Nov 2004	Jiddah	Jimm	House 1

DK	Sex	Name	Conceived	Birth	Dam	Sire	Birth location / comments
29	F	Maisha DK 28	20 Sep 2004	21 Dec 2005	Musso	isis	New house
30	M	Jamie DK 29	6 Oct 2004	2 Jan 2006	Jessi	Sauron	House 1
31	F	Etosha DK 30	17 Jun 2005	4 Sep 2006	Elba	Jimm	House 1
32	M	Jabu DK 31	7 Oct 2005	1 Feb 2007	Jola	Isis	New house
33	M	— DK 32	25 Aug 2006	22 Sep 2007	Jane Lee	Mweru	New house, aborted on day 393, 29 kg
34	M	Dzanty DK 33	10 Aug 2006	24 Nov 2007	Jiddah	Jimm	House 1
35	F	Eva DK 34	26 Jul 2008	8 Dec 2009	Elba	Baringo	House 1
36	F	Jasmina DK 35	3 Sep 2008	13 Dec 2009	Jessi	Baringo	House 1
Total 35 (13,22) calves of which 31 (11,20) were reared, plus there was 1 calf aborted on day 18.							



Jessi DK 5 and five-month-old Jeremy DK 24, 8 May 2001 (lh)

BIOLOGICAL DATA

Gestation and length of cycles in females

Given that the mating in the black rhino usually takes several tens of minutes, not only pregnancy data could be obtained but also that on the length of cycles in females. Pregnancy recorded ranged from 427 to 492 days with an average of 458.5. Females cycled in the range of 21 to 29, with an average of 25 days. The maximum-recorded length of mating events was 45 minutes, while a minimum was 7 minutes.

According to the International Studbook (GOLTENBOTH and OCHS, 1997) summarising the captive breeding in the 1904 to 1996 period, when there were 302 and 33 births of the eastern and southern subspecies of the black rhinoceros, respectively, the average gestation period was 455 days. ASSENBERG *et al.* (2008) indicates a gestation period of 440 to 460 days and the length of cycle 21 to 28 days.

Mating, the length of the cycle and pregnancy period in black rhinos at Dvur Kralove Zoo prior to 31 December 2009

No.	Pair	Mating date / time	Cycle length	Birth date	Name	Pregnancy period
1	Elsa x Ken/King	20 Jul 1976 mated by two males	?	2 Oct 1977	Elvira DK 1	439 days
2	Sabi x Ken	21 Mar 1977, 15 Apr 1977	25 days	5 Jul 1978	Sali DK 2	456 days
3	Jimmi x King	19 Aug 1977, 6 Dec 1977 (by night)?	?	18 Mar 1979	Jimm DK 3	467 days
4	Elvira x Isis	26 Jan 1983, 17 Feb, 20 Feb 1983	25 days	15 May 1984	Eli DK 4	450 days
5	Jimmi x Isis	15 May 1983, 9.-10 Jun, 4 Aug 1983	25-28 days	8 Dec 1984	Jessi DK 5	462 days
6	Sali x Isis	21 Apr 1985	?	28 Aug 1986	Sado DK 6	492 days
7	Jimmi x Isis	13 Feb 1988 (45 min)	?	21 May 1989	Jos DK 7	463 days
8	Sali x Isis	18 Apr 1988 (30 min); 28 Jun 1988 (30 min)	?	1 Oct 1989	Sany DK 8	460 days
9	Elvira x Isis	6 May 1989, 23 May, 29 May 1989	?	24 Aug 1990	Eimi DK 9	452 days
10	Jessi x Eli	24.-25. 1., 8 Apr 1990 - struggling, 9 May female chased	25-27 days	23 Jun 1991	Jacob DK 10	443 days
11	Jimmi x Isis	10.-11 Jun 1990 (30 min)	?	13 Sep 1991	Jasper DK 11	459 days
12	Sali x Jimm	22 Nov 1990	?	24 Feb 1992	Sára DK 12	459 days
13	Elvira x Jimm	31 Aug, 21 Sep 1991 (30 min)	22 days	8 Dec 1992	Etna DK 13	444 days
14	Jarca x Jimm	7 Aug, 1 Sep 1991	25 days	14 Dec 1992	Jaga DK 14	470 days
15	Jimmi x Mabú	16 Dec 1992, 8 Feb 1993 (29 min)	27 days	11 Apr 1994	— Sldb #763	427 days
16	Sali x Cody	29 May, 30 May, 26 Jun, 16 Jul 1993 (9+35 min)	21-27 days	28 Oct 1994	Sauron DK 15	467 days
17	Jessi x Mabú	18 Mar, 21 May, 20 Jul, 17 Aug 1993 (30 min)	28 days	15 Nov 1994	Jiddah DK 16	455 days
18	Jarca x Cody	24 Apr, 20 Jun, 14 Jul, 15 Jul, 7 Aug, 2 Sep 1994	28 days	4 Dec 1995	Jonas DK 17	458 days
19	Eimi x Cody	23 May 1995 (25 min)	?	5 Aug 1996	Elba DK 18	440 days
	Elvira x Cody	3 Jun 1995 (35 min)	?	21 Jun 1995	— DK 19	Aborted on pregnancy day 18

No.	Pair	Mating date / time	Cycle length	Birth date	Name	Pregnancy period
20	Sali x Jimm	25 May 1996 (25 min)	?	20 Aug 1997	Musso DK 20	452 days
21	Jessi x Mabu	1 Jul 1996	?	25 Oct 1997	Jola DK 21	481 days
22	Jimmi x Isis	17 Mar, 2 Jun, 5 Sep, 4 Oct 1996 (?)	29 days	24 Jan 1998	Jane Lee DK 22	476 days
23	Sali x Jimm	17 Sep, 13 Oct 1998	26 days	25 Jan 2000	Salome DK 23	441 days
24	Jessi x Jimm	23 Aug, 16 Sep 1999 (46 min)	24 days	21 Dec 2000	Jeremy DK 24	461 days
25	Eimi x Sauron	27 Mar, 17. 5, 10 Jun 2001 (30 min)	24 days	24 Aug 2002	--- F DK 25	450 days
26	Elba x Jimm	4 Aug 2001 (30 min)	?	2 Nov 2002	Ema Elsa DK 26	455 days
27	Jiddah x Jimm	12 May, 5 Jun 2003 (40-45 min)	24 days	11 Sep 2004	Deborah DK 27	464 days
28	Musso x Isis	25 Aug, 20 Sep 2004 (30 min)	26 days	21 Dec 2005	Maisha DK 28	457 days
29	Jessi x Sauron	12 Sep, 6 Oct 2004 (32 min)	24 days	2 Jan 2006	Jamie DK 29	452 days
30	Elba x Jimm	23 May, 17 Jun 2005 (30 min)	25 days	4 Sep 2006	Etosha DK 30	444 days
31	Jola x Isis	11 Jul, 7 Aug, 7 Oct 2005 (26 min)	26-27 days	1 Feb 2007	Jabu DK 31	482 days
32	Jane Lee x Mweru	15 Jun, 8 Jul, 31 Jul, 25 Aug 2006	23-25 days	22 Sep 2007	— M DK 32	393 days - abortion
33	Jiddah x Jimm	10 Aug 2006 (7 a 36 min)	?	24 Nov 2007	Dzanty DK 33	471 days
34	Elba x Baringo 2	26 Jul (25 min), 20 Aug 2008 (10+29 min)	25 days	8 Dec 2009	Eva DK 34	475 days
35	Jessi x Baringo 2	4 Sep 2008 (25 min)	?	13 Dec 2009	Jasmina DK 35	465 days
Pregnancy range 427-492 days, Cycle length 25 (21-29) days						

Sex ratio

Out of the 35 calves born at Dvur Kralove Zoo, 13 animals were males and 22 were females, with male to female ratio 1:1.7. According to the International Studbook (KLOS and FRESE 1987) summarising the births in captivity from 1969 to 1986, there were 127 births with a sex ratio of 62 males and 65 females, meaning the ratio of males to females was 1:1.05. Under normal conditions, a single calf is born, despite the two cases of aborted twins out of the total 590 births prior to the end of 2009 reported by the International Studbook (FRESE 2009).

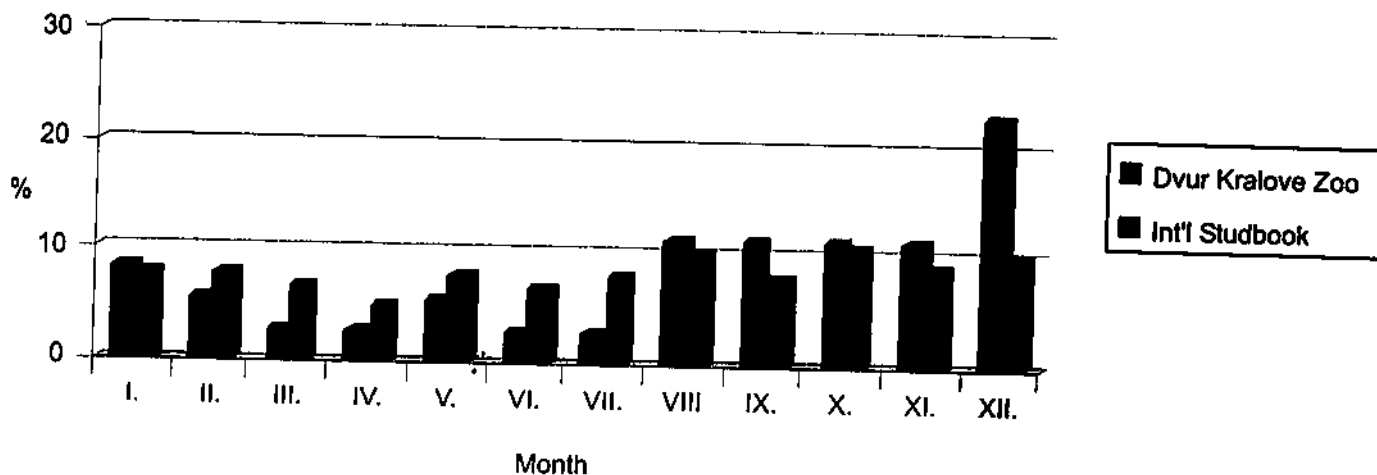
Birth distribution over the year

The births were recorded throughout the year with a maximum from July to December. This is in particular due to breeding the females in times of the year with favourable climate. Similar information is also confirmed by the International Studbook, where most births were recorded in the second half of the year, probably as a result of coupling, thus mating especially in spring and summer months (KLOS a FRESE 1991). The following table shows the distribution of births at Dvur Kralove Zoo and in captivity according to the last volume of the International Studbook (FRESE 2009) summarising the data until 2 December 2009. In the wild, births are distributed throughout the year with a peak during the rainy season in some areas (ASSEBERG *et al.* 2008). The chart shows the comparison of the data from the studbook and Dvur Kralove Zoo in the percentage of births attributable to each month. The International Studbook data comprise a total of 590 births distributed throughout the year, with 5 to 11% of births per month (FRESE 2009).

The distribution of births over the year in the black rhino at Dvur Kralove Zoo prior to 31 December 2009 and in captivity

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
No. of births	3	2	1	1	2	1	1	4	4	4	4	8	35
%	8.6%	5.7%	2.9%	2.9%	5.7%	2.9%	2.9%	11.4%	11.4%	11.4%	11.4%	22.9%	100%
Births in captivity (FRESE 2009)	48	47	43	32	47	41	47	60	46	67	52	60	590
% per month	8%	8%	7%	5%	8%	7%	8%	10%	8%	11%	9%	10%	100%

Birth distribution over the year in black rhino in captivity



Birth intervals and reproductive age

The data from the wild imply that females are sexually mature at the age of 3.8 to 9.1 years, with an average of 6.3 years (SMITH and READ 1992) and deliver in the interval of 2-3.5 years. The birth interval in the females in the Ngorongoro Crater from 1993 to 2003 was 2.88 years on average; the females were first giving birth at the age of 6.9 years (MILLS *et al.* 2003). The shortest birth interval between births of two calves of one female is 24 to 26 months and may take 27 to 30 (max. 39) months (SMITH and READ 1992). It results from the captive-based data up to the end of 2009 (FRESE 2009) involving 195 females and 592 calves that the age range of the youngest females giving birth was 3 years and 10.5 months to 5 years, the oldest primiparas were 17-25 years old and the oldest females giving birth were 33 to 37 years old, while the maximum number of calves per female was 10 to 14 (Stdbook #213 - Ella, a currently 39-year-old female that has been living in San Francisco, USA, since 1974).

At Dvur Kralove Zoo, there were a total of 13 females that ever gave birth where three of those 13 females first delivered when 6 to 6.5 years old, i.e. conceived when 4 to 5 years old (Sabi, Eimi DK 9, Elba DK 19); the age of 5 to 6 years was one of the first conception in three females (Elsa, Elvira DK 1 and Jessi DK 5). The first conception between 7 and 8 occurred in three females (Jimmi, Sali DK 2 and Musso DK 20). Between 8 and 9, three females conceived (Jiddah DK 17, Jola DK 21 and Jane Lee DK 22). Jimmi and Sali gave the birth later, because they had to wait until Isis, the only male at that time, reached maturity. Isis became a father for the first time when 6 years and 6 months old, meaning he reached the sexual maturity at the turn of the year 4 and 5. For the other females that conceived for the first time only between the year 7 and 9, this involved a late coupling with a male because of a longer process of familiarisation and socialisation as the animals were still young and also excessive caution and delaying the coupling due to the inexperience of some keepers and curators. In Jane Lee, it could be also the influence of sexual immaturity and inexperience of male Mweru, which was coupled with this female, mating her (with subsequent conception of the female) when 7 years and 9 months old. Female Jiddah

did not conceive sooner for the first time than when 8.5 years old since she was very severely attacked when five years old by male Sauron DK 16 despite the female grew up with this male once weaned. Jiddah's very bad experience with this male caused that the female had to be coupled with her half-brother Jimmy, who was behaving very quietly in connecting with females. To facilitate coupling with Jimm, Jiddah was first coupled with an experienced female Sali, which in addition caused some delay. That was why the process of coupling with Jimm was taking place with three animals involved, where Sali played a very positive role.

The oldest primiparous female was Jarca, who first gave birth in 22 years, thus getting pregnant between 20 and 21 year of her life. The reason was that even though Jarca as a young female was initially living with males, including young Isis, over a few following years, she was not paired with any male. Subsequently, once coupled with Isis, the female was repeatedly attacked and therefore lived for several years on her own. Since spring 1987, when Jarca was 17, attempts of coupling this female with a male began (VONDRA *et al.* 1994). After being repeatedly stimulated concerning oestrus, using two preparations - Alestrum on 24 September 1987 and PMSG on 12 October 1987, Jarca was repeatedly coupled with male Isis, who was however attacking the female all the time. Therefore, since 1988, Jarca was united with Elvira DK 1, and male Isis was added after 6 days to the females (VONDRA *et al.* 1994). Although females were getting along well with each other, the relationship between Jarca and Isis remained unchanged. On 3 May 1989, Jarca was anaesthetised and her genital organs were examined. Subsequently, regular sampling of female's urine was initiated used for detecting rhino's hormonal cycles (for testing, the samples were shipped to London - Prof Dr K Hodges). From 5 November 1989, preparative REGUMATE was administered to Jarca to induce oestrus, 37.5 ml per day over the period of 12 days (VONDRA *et al.* 1994). In late 1989, the male was replaced and Jarca was coupled with a very calm, but still inexperienced Jimm. First, Jimm was contacted with Jarca in the enclosure over the fence (26/12 - 27/12 1989), and as the animals showed no aggression, Jimm was moved into the neighbouring box within the indoor facility (5 March 1990). Jarca was re-anaesthetised and re-examined, receiving REGUMATE over the period of 12 days from 17 February 1990; this time it was 50 ml/day (VONDRA *et al.* 1994). From 29 March, both animals were administered DIAZEPAM for calming, and on 1 April 1990, they were brought together in the enclosure the first time, which was taking place very quietly with the exception of a single struggle. The next day, Jimm tried to mate the female. As Jarca was obviously in oestrus, the same day she was also coupled with Isis; however, Isis was replaced by Jimm again for sharp struggling. Jimm tried to mate Jarca from 12 to 13 April and then on 21 April 1990, when the first successful mating took place the next day (22 April), which was repeated in the following months (24 June, 26 August, 24 September, 3 December, 2 January 1991, 24 February and 28 March 1991). The next-month, mating attempts were recorded by keepers (nonetheless, mating could happen as well) and the mating as such was observed on 7 August and 1 September 1991 (VONDRA *et al.* 1994). To promote the cycle, concentrated vitamin E (TPGS) was administered to Jarca from 13 to 22 February 1991 at a dose of 60 ml/day, with subsequent injection of 8 ml Supergestrogen on 10 April 1991. Simultaneously, Jarca was re-united with female Elvira on 8 August 1991 and the two females then continued going into the same enclosure with Jimm, until early November. Jimm mated both females (Elvira on 31 August and 21 September 1991). From 4 November 1991, faeces samples were collected weekly from each female and subsequently investigated by Dr Schwarzenberger at Veterinary University of Vienna. Both females were confirmed pregnant; they continued going outdoors together up to 10 October 1992 and then separated even in the outer enclosure before the nearing birth (VONDRA *et al.* 1994). For birth, each female had available a delivery double-box with the area of 40 sq m. Each box was fitted with CCTV cameras connected to a video recorder later used for recording the birth. The advanced age of Jarca was reflected in the low birth weight of the young (26 kg - female Jaga DK 14), which was unable to suckle by itself and was hand-raised (for more details, see page 132). The oldest female giving birth was Jimmi, who delivered in 28, thus was successfully mated when nearly 27 years old. Jimmi was still repeatedly mated when 29 years old after weaning of her last calf, but was no longer pregnant. Later on, only a regular interest of the male and mating attempts were recorded in Jimmi, quite regularly until the spring 2002 (the female was 32 years old); most recently this was in July 2005 (Jimmi was 35 years old). Since that time, Jimmi was without any sexual activity but still lived in her enclosure with Isis at that time with no problems. Other females gave birth to a last calf at a younger age, because their reproduction was either terminated prematurely by their death, or are still relatively young and still can reproduce (Jessi, the oldest living breeding female following Jimmi, last conceived in 2008 when 24).

Birth intervals

The table on page 116 summarises data on birth intervals in each female, showing that from 1990 to 2000, the females were often giving birth in intervals of 2-3 years, which was owing to the breeding management, when the calves used to be weaned when around 1 year old and often combined in nurseries comprising individuals of the same age. Before 1990, the intervals used to be longer, which was caused by the death of all breeding males and the absence of a sexually mature male. From 2000 to 2007, the birth interval was less than 4 years up to more than 5 years, which was determined by the separation of calves from their mothers not before the age of 2 years or even later. In addition, sometimes the mating period lasted several months before the female got

pregnant. Two of the females, Jimmi and Sali DK 2, delivered 6 calves before the end of their reproductive period or death. All other females either died before reaching the end of their reproductive age or still live and show cycles.

FRESE (2009) reports the shortest intervals between births (full-term calves only) to be 478 to 527 days, i.e. 16 to 18 months. Therefore, a significantly lesser number of offspring was achieved compared with data from the wild. Throughout the breeding period, females were always coupled only after weaning of their calf as neither a female was ever coupled with a male in the presence of female's young as it is in the wild because of concerns regarding the calf, nor the calf was ever returned to the female following successful mating. Only in 2009, female Jiddah DK 17 was coupled with the male after having been separated from her calf over a short time (for more details, refer to page 105). Making nurseries from 2 to 3 calves of approximately same age proved good. Likewise, bringing adult animals together was successfully carried out repeatedly by combining two and sometimes even three females with a single male. This increased safety, especially in the case of a young inexperienced females that was added to the experienced one (e.g. to Jimmi and Sali DK 2), as well as helped the females to prevent possible attacks by the males together, which in turn was a safer option for them.

The birth interval varied from 2 years and 3.5 months (27.5 months) up to 6 years and 3.5 months (75.5 months), but mostly less than 3 to less than 4 years (29 to 42 months). The average intervals between births in females giving birth at least twice were as follows (N = number of intervals):

Female	Jimmi	Jarca	Elvira DK 1	Sali DK 2	Jessi DK 5	Eimi DK 9	Jiddah DK 17	Elba DK 19	Jola DK 21
Interval	45.2 months	36 months	51.5 months	32.5 months	44.3 months	71.5 months	38.5 months	42.5 months	43 months
No. of intervals	5	1	2	5	5	1	1	2	1

ASSENBERG *et al.* (2008) provide sexual maturity of females and males in the wild between the fourth and sixth, or seventh and ninth year of age, respectively, while females deliver their first calf around the fifth year, or exceptionally, up to about the twelfth year of age. At the same time, cycles begin in the females still during lactation. Gestation period of 440-460 days, as well as the birth interval around 27 months in the wild and 40 months in captivity is indicated in the work above. This difference is explained by probably delayed coupling of females after birth in captivity.

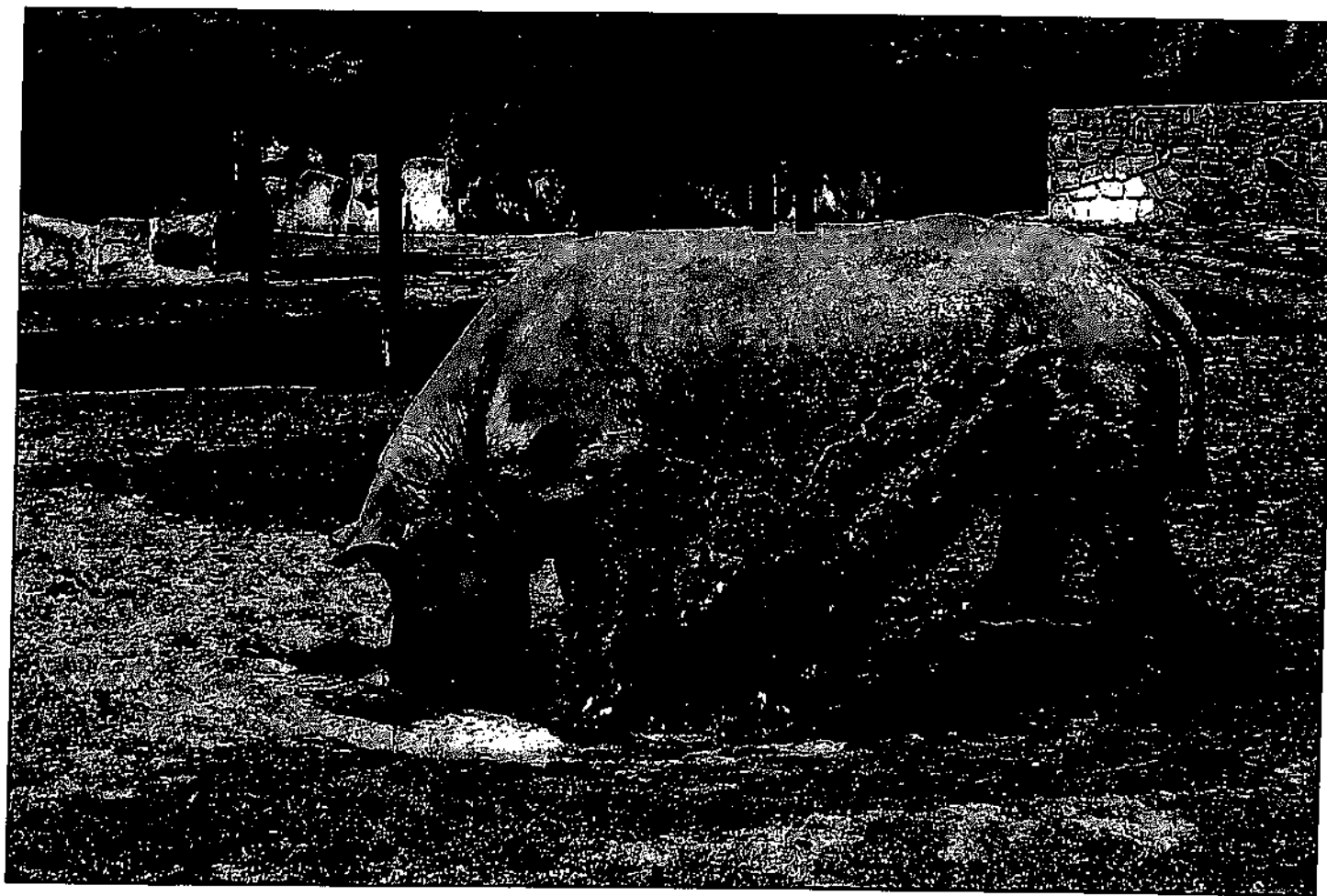
It results from the captive-based data up to the end of 2009 (FRESE 2009) involving 150 males and 579 descendants that the youngest mating males were 3 years and 3.5 months to 5 years old, the highest age in first mating was 15 to 25 years and the oldest mating breeding males were 30 to 35 years, while the maximum number of descendants per male was 10 to 17.

Age at birth and the intervals between births in female black rhinos at Dvur Kralove Zoo prior to 31 December 2009

Female * Born * Died	Birth No.	Birth date, calf	Female age at birth	Female age at mating (app. 15 months prior par- tition)	Birth interval (years, months)	Raised success- fully
Elsa * 1970 Kenya	1.	2 Oct 1977 Elvira DK 1	7 years	App 6 years	—	Yes
Jimmi * February 1970 Kenya	1.	18 Mar 1979 Jimm DK 3	9 years, 1 month	7 years, 10 months	—	Yes
	2.	8 Dec 1984 Jessi DK 5	14 years, 10 months	13 years, 7 months	5 years, 9 months	Yes
	3.	21 May 1989 Jos DK 7	19 years, 3 months	18 years	4 years, 5.5 months	Yes
	4.	13 Sep 1991 Jasper DK 11	21 years, 7 months	20 years, 4 months	2 years, 4 months	Yes
	5.	11 Apr 1994 - DK 15	23 years, 2 months	21 years, 11 months	2 years, 7 months	No
	6.	24 Jan 1998 Jane Lee DK 22	28 years	26 years, 9 months	3 years, 8.5 months	Yes

Female * Born + Died	Birth No.	Birth date, calf	Female age at birth	Female age at mating (app 15 months prior par- turation)	Birth interval (years, months)	Raised success- fully
Jarca * February 1970 Kenya	1.	14 Dec 1992 Jaga DK 14	22 years	App 20 years	—	Yes
	2.	4 Dec 1995 Jonas DK 18	25 years	App 23 years	3 years	No
Sabi * 1972 Kenya	1.	5 Jul 1978 Sali DK 2	6 years	App 5 years	—	Yes
Elvira DK 1 * 2 Oct 1977 Dvur Kralove	1.	15 May 1984 Eli DK 4	6 years, 7.5 months	5 years, 4.5 months	—	Yes
	2.	24 Aug 1990 Eimi DK 9	12 years, 11 months	11 years, 8 months	6 years, 3.5 months	Yes
	3.	8 Dec 1992 Etna DK 13	15 years, 2 months	13 years, 9 months	2 years, 3.5 months	Yes
Sali DK 2 * 5 Jul 1978 Dvur Kralove	1.	26 Aug 1986 Sado DK 6	8 years, 2 months	6 years, 9 months	—	Yes
	2.	1 Oct 1989 Sany DK 8	11 years, 3 months	10 years	3 years, 1 month	Yes
	3.	24 Feb 1992 Sára DK 12	13 years, 6 months	12 years, 3 months	2 years, 4.5 months	Yes
	4.	26 Oct 1994 Sauron DK 16	16 years, 4 months	15 years, 1 month	2 years, 8 months	Yes
	5.	20 Aug 1997 Musso DK 20	19 years, 2 months	17 years, 11 months	2 years, 10 months	Yes
	6.	25 Jan 2000 Jane Lee DK 23	21 years, 7 months	20 years, 4 months	2 years, 5 months	Yes
Jessi DK 5 * 8 Dec 1984 Dvur Kralove	1.	23 Jun 1991 Jacob DK 10	6 years, 6.5 months	5 years, 3.5 months	—	Yes
	2.	15 Nov 1994 Jiddah DK 17	9 years, 11 months	8 years, 8 months	3 years, 5 months	Yes
	3.	25 Oct 1997 Jola DK 21	12 years, 10.5 months	11 years, 7.5 months	2 years, 11 months	Yes
	4.	21 Dec 2000 Jeremy DK 24	16 years, 0.5 month	14 years, 9.5 months	3 years, 2 months	Yes
	5.	2 Jan 2006 Jamie DK 29	21 years, 1 month	19 years, 10 months	5 years, 0.5 month	Yes
	6.	13 Dec 2009 Jasmina DK 35	25 years	23 years, 9 months	3 years, 11 months	Yes
Eimi DK 9 * 24 Aug 1990 Dvur Kralove	1.	5 Sep 1996 Elba DK 19	6 years, 0.5 month	4 years, 9.5 months	—	Yes
	2.	24 Aug 2002 — DK 25	12 years	10 years, 9 months	5 years, 11.5 months	No
Jiddah DK 16 * 15 Nov 1994 Dvur Kralove	1.	11 Sep 2004 Deborah DK 27	9 years, 10 months	8 years, 7 months	—	Yes
	2.	24 Nov 2007 Dzanty DK 33	13 years	10 years, 9 months	3 years, 2.5 months	Yes
Elba DK 18 * 5 Sep 1996 Dvur Kralove	1.	2 Nov 2002 Erna Elsa DK 26	6 years, 2 months	4 years, 11 months	—	Yes
	2.	4 Sep 2006 Etosha DK 30	10 years	8 years, 9 months	3 years, 10 months	Yes
	3.	8 Dec 2009 Eva DK 34	13 years, 3 months	12 years	3 years, 3 months	Yes

Female * Born + Died	Birth No.	Birth date, calf	Female age at birth	Female age at mating (app. 15 months prior par- turtion)	Birth interval (years, months)	Raised suc- cess- fully
Musso DK 20 * 20 Aug 1997 Dvur Kralove	1.	21 Dec 2005 Maisha DK 28	8 years, 3 months	7 years	—	Yes
Jola DK 21 * 25 Oct 1997 Dvur Kralove	1.	1 Feb 2007 Jabu DK 31	9 years, 3.5 months	8 years, 0.5 month	—	Yes
	2.	Conceived on 8 Jun 2009 DK 36		11 years, 7.5 months	3 years, 7 months	
Jane Lee DK 22 * 24. Jan 1998 Dvur Kralove	1.	22 Sep 2007 - DK 32	9 years, 8 months	8 years, 5 months	—	No



Age at time of mating in male black rhinos at Dvur Kralove Zoo prior to 31 December 2009

Male * Born	No. of calf	Birth date, calf	Male age at birth of the calf	Male age at time of mating (app. 15 months earlier)	Raised succes- sfully
Ken * January 1970 Kenya	1. ??	2 Oct 1977 Elvira DK 1 ??	7 years	6 years	Yes
	2.	5 Jul 1978 Sali DK 2	8 years	7 years	Yes
King *1970 Kenya	1. ??	2 Oct 1977 Elvira DK 1 ??	7 years	6 years	Yes
	1. (or 2.)	18 Mar 1979 Jimm DK 3	9 years	8 years	Yes
Isis * 3 Nov 1977 Cincinnati	1.	15 May 1984 Eli DK 4	6 years, 6.5 months	5 years, 3.5 months	Yes
	2.	8 Dec 1984 Jessi DK 5	7 years, 1 month	5 years, 10 months	Yes
	3.	26 Aug 1986 Sado DK 6	8 years, 10 months	7 years, 7 months	Yes
	4.	21 May 1989 Jos DK 7	11 years, 7 months	10 years, 4 months	Yes
	5.	1 Oct 1989 Sany DK 8	11 years, 11 months	10 years, 8 months	Yes
	6.	24 Aug 1990 Elmi DK 9	12 years, 10 months	11 years, 7 months	Yes
	7.	13 Jul 1991 Jasper DK 11	13 years, 8.5 months	12 years, 5.5 months	Yes
	8.	24 Jan 1998 Jane Lee DK 22	20 years, 3 months	19 years	Yes
	9.	21 Dec 2005 Maischa DK 28	28 years, 2 months	26 years, 11 months	Yes
	10.	1 Feb 2007 Jabu DK 31	29 years, 3 months	28 years	Yes
Jimm DK 3 * 18 Mar 1979 Dvur Kralove	1.	24 Feb 1992 Sára DK 12	12 years, 11 months	11 years, 8 months	Yes
	2.	8 Dec 1992 Etna DK 13	13 years, 9 months	12 years, 6 months	Yes
	3.	14 Dec 1992 Jaga DK 14	13 years, 9 months	12 years, 6 months	Yes
	4.	20 Aug 1997 Musso DK 20	18 years, 5 months	17 years, 2 months	Yes
	5.	25 Jan 2000 Salome DK 23	20 years, 10 months	19 years, 7 months	Yes
	6.	21 Dec 2000 Jeremy DK 24	21 years, 9 months	20 years, 6 months	Yes
	7.	21 Nov 2002 Ema Elsa DK 26	22 years, 8 months	21 years, 5 months	Yes
	8.	11 Sep 2004 Deborah DK 27	24 years, 6 months	23 years, 3 months	Yes
	9.	4 Sep 2006 Etosha DK 30	26 years, 6 months	25 years, 3 months	Yes
	10.	24 Nov 2007 Dzanty DK 33	27 years, 8 months	26 years, 5 months	Yes
Eli DK 4 * 15 May 1984 Dvur Kralove	1.	23 Jun 1991 Jacob DK 10	7 years, 1 month	5 years, 11 months	Yes
Cody * 20 May 1975 Sydney	1.	26 Oct 1994 Sauron DK 16	9 years, 5 months	8 years, 2 months	Yes
	2.	4 Dec 1995 Jonas DK 18	10 years, 7 months	9 years, 4 months	No
	3.	5 Sep 1996 Elba DK 19	11 years, 3.5 months	10 years, 0.5 month	Yes

Male * Barn	No. of calf	Birth date, calf	Male age at birth of the calf	Male age at time of mating (app 15 months earlier)	Raised succes- sfully
Mabu * 23 Jan 1979 Magdeburg	1.	11 Apr 1994 - Early abortion	15 years, 2.5 months	13 years, 11.5 months	No
	2.	15 Nov 1994 Jiddah DK 17	15 years, 10 months	14 years, 7 months	Yes
	3.	25 Oct 1997 Jola DK 21	18 years, 9 months	17 years, 6 months	Yes
Sauron DK 15 * 26 Oct 1994 Dvur Kralove	1.	24 Aug 2002 — DK 25	7 years, 10 months	6 years, 7 months	No
	2.	2 Jan 2006 Jamie DK 29	11 years, 3.5 months	10 years, 0.5 month	Yes
Mweru * 12 Sep 1996 Port Lympne	1.	22 Sep 2007 — DK 32	11 years	9 years, 9 months	No
	2.	7 Sep 2010 DK 36	14 years	12 years, 9 months	?
Baringo II * 3 Dec 1992 Port Lympne	1.	8 Dec 2009 Eva DK 34	17 years	15 years, 9 months	Yes
	2.	13 Dec 2009 Jasmina DK 35	17 years	15 years, 9 months	Yes



A female black rhino with a calf and older daughter, Lewa, Kenya (dh)

Weaning

In the wild, the calf is weaned depending on when the female gives the next birth, nursed usually more than a year, while solid food is taken already during the first weeks of life and independence is reached in the age of 2.5-3.5 years (ASSENBERG *et al.* 2008). If the female gives birth, then if the previous calf is a male, it is driven off, while if the previous calf is a female, it usually remains with the mother.

Weaning used to be carried out at Dvur Kralove Zoo within the range of 11 to 25 months, only female Elvira was weaned in a half of year because of her mother's death. If a calf was moved to a different house immediately upon weaning and grouped with other calves, including those of white rhinoceroses, they managed the weaning process very well and in a few days, they already stopped looking for its mother. If, however, a gradual weaning process with the calf living next to its mother posed stress to both the mother and the calf that called the mother for many weeks, which in turn led to the re-union with the mother. From the perspective of future prosperity and breeding potential of the calf, any earlier weaning had no negative influence. Rather, it created an even stronger bond between keepers and the rhino. It was not by chance that females Elvira DK 1 (weaned at 6 months) and Sali DK 2 (weaned at 15 months) could be milked during their lactation periods. Only in one case (female Jiddah DK 17 in 2009) the weaning process was implemented gradually over a part of the day when the young was left inside the house and the mother was coupled with the male in the enclosure, where mating occurred. Weaning in the age of 12-15 months and joining the young into nurseries, immediately after separation from the mother, worked best, where age differences of several months between the calves played no negative role. Detailed information about the weaning of calves is summarised in the table below. Females were weaned between 6-29 months of age, 15.8 months on average. Males were weaned between 10-29 months of age, with average age of 18.2 months.

Weaning of young black rhinos at Dvur Kralove Zoo prior to 31 December 2009

No.	Sex	Name	Birth date	Dam	Str	Weaning method (Age: M-months, Y-years)	Comment
1	F	Elvira	2 Oct 1977	Elsa	Ken/King	7 Apr 1978 - 6M - Following death of female, alone prior to 21 Jun 78 - Started going outdoors with Jarca	Excellent mother, calm
2	F	Sali	5 Jul 1978	Sabi	Ken	12 Oct 1979 - 1Y+3M - Immediately grouped with Elvira (2Y) and Isis (1Y+11M)	Excellent mother, calm
3	M	Jimm	18 Mar 1979	Jimmi	King	13 Apr 1981 - 2Y+1M - Immediately moved to another house, where immediately grouped with Sali (2Y+9.5M), Isis (2Y+5M) and Elvira (2.5Y)	Breeding male, calm
4	M	Eli	15 May 1984	Elvira	Isis	18 Aug 1986 - 2Y+3M - Stayed alone	Breeding male
5	F	Jessi	8 Dec 1984	Jimmi	Isis	9 Sep 1986 - 1Y+9M - Alone and nervous, will not want to go out	Excellent mother, nervous
6	M	Sado	26 Aug 1986	Sali	Isis	22 Nov 1987 - 1Y+3M - Immediately moved to another house	
7	M	Jos	21 May 1989	Jimmi	Isis	19 Apr 1990 - 11M - Mother moved to a different place, 26 Jun (1Y+1M) grouped with Najin (nearly 1Y) and 1 Aug grouped with Sany (10M)	
8	F	Sany	1 Oct 1989	Sali	Isis	1 Aug 1990 - 10M - Immediately grouped with Jos (1Y+2M) and Najin (11M)	
9	F	Eimi	24 Aug 1990	Elvira	Isis	31 Jul 1991 - 11M - Mother moved to a different place immediately	Excellent mother, calm
10	M	Jacob	23 Jun 1991	Jessi	Eli	31 Jul 1992 - 1Y+1M - Immediately united with Jasper (10.5M)	
11	M	Jasper	13 Sep 1991	Jimmi	Isis	31 Jul 1992 - 10.5M - Immediately united with Jacob (1M)	

No.	Sex	Name	Birth date	Dam	Stir	Weaning method (Age: M-months, Y-years)	Comment
12	F	Sara	24 Feb 1992	Sali	Jimm	5 Apr 1993 - 1Y+1.5M - Immediately moved to a different place, where joined Jacob (1Y+9M) and Jasper (1Y+6.5M)	
13	F	Etna	8 Dec 1992	Elvira	Jimm	10 Mar 1994 - 1Y+3M - Immediately united with Jaga (1Y+3M)	Excellent mother, calm
14	F	Jaga	14 Dec 1992	Jarca	Jimm	10 Mar 1994 - 1Y+3M - Immediately united with Etna (1Y+3M)	Excellent mother, calm; problems with males
16	M	Sauron	26 Oct 1994	Sali	Cody	27 Oct 1995 - 1Y - 7 Nov United with Jaga	Breeding; aggressive at young age
17	F	Jiddah	15 Nov 1994	Jessi	Mabu	14 May 1996 - 1.5Y - Moved to a different place, on 15 May united with Sauron (1Y+6.5M) and Jaga (3.5Y)	Excellent mother, calm
19	F	Elba	5 Aug 1996	Eimi	Cody	30 Jul 1997 - 1Y - Moved to a different part of the house	Excellent mother, calm
20	F	Musso	20 Aug 1997	Sali	Jimm	31 Jul 1998 - 11.5M - Immediately united with Elba (2Y) - not at night	Excellent mother, calm
21	F	Jola	25 Oct 1997	Jessi	Mabu	17 Mar 1999 - 1Y+5M - Immediately united with Jane Lee (1Y+2M)	Excellent mother, more nervous
22	F	Jane Lee	24 Jan 1998	Jimmi	Isis	17 Mar 1999 - 1Y+2M - Immediately united with Jola (1Y+5M)	Nervous
23	F	Salome	25 Jan 2000	Sali	Jimm	31 May 2001 - 1Y+4M - Moved within the same house	Breeding female
24	M	Jeremy	21 Dec 2000	Jessi	Jimm	18 May 2003 - 2Y+3M - Moved within the same house	
26	F	Ema-Elsa	2 Nov 2002	Elba	Jimm	6 Apr 2005 - 2Y+5M - Moved within the same house	Breeding female
27	F	Deborah	11 Sep 2004	Jiddah	Jimm	26 Jul 2006 - 1Y+10.5M - Moved within the same house	Calm
28	F	Maisha	21 Dec 2005	Musso	Isis	14 Jul 2007 - 1Y+7M - Mother died, united with Jamie on 20 July	Calm
29	M	Jamie	2 Jan 2006	Jessi	Sauron	20 Jul 2007 - 1Y+6.5M - Immediately moved to a different place, united with Maisha	Calm
30	F	Etosha	4 Sep 2006	Elba	Jimm	8 Jul 2008 - 1Y+10M - Immediately united with Davu - not at night	Calm
31	M	Jabu	1 Feb 2007	Jola	Isis	1 Nov 2008 - 1Y+9M - Inside the house, getting calm when moved next door to the young trio (Jamie, Maisha and Deborah); 12 Dec joined Deborah (4Y+3M)	Calm
33	M	Dzanty	24 Nov 2007	Jiddah	Jimm	16 Oct 2009 - 1Y+11M - Separated step by step during the day for 30 minutes up to several hours from 6 May (Mother coupled with the male from 18 May)	Nervous when being separated from the mother

Weight in black rhinoceroses

Over the years, a number of weight data have been acquired. Initially, this occurred at random, usually in connection with the transport or deaths of animals; after 1990, the data were obtained specifically, particularly in relation to artificial rearing (VONDRA *et al.* 1994), after-birth inspection of calves and following installation of a weighing instrument inside a new rhino house in 1993, which could be used to take weight in adult animals (HOLECKOVA, 1995). In 2008, scales were installed in both of the rhino houses and weighing became an important instrument for monitoring the condition of the animals. A total of 280 weight data were obtained, including 124 data for males and 156 for females.

Weight of adult animals

In total, over 160 weight-related data were obtained in adult individuals (8 males and 13 females), implicating that the weight of adult males varied from 948 to 1,350 kg, and the mean individual weight ranged from 948 to 1240 kg. Similarly, the weight of adult females varied from 560 to 1292 kg, while the mean weight of individual animals ranged from 560 to 1,280 kg, where the lowest weight values were recorded in animals close to or at the time of death; therefore, they were individuals in a poor physical condition. Further details are summed up in the following tables, showing the average weight of about 1,100 kg in males and 950 kg in females. The collected data can be compared with that from other animal parks (ARKS), where a 5-year-old male Limpopo (Stdbk # 889) weighed 930 kg (Port Lymgne), male Quinto (Stdbk # 430) weighed 1,093 to 1,133 kg (Chester), male Pete (Stdbk # 376) 1,100 kg as 12 years old (Washington), female Laikipia (Stdbk # 891), five-year-old, weighed 908 kg (Port Lymgne), female Emma (Stdbk # 451) 1000-1065 kg in its year 10 (Whipsnade), 31-year-old female Mtoto (Stdbk # 150) 762 kg (Zurich), 27-year-old female Nzima (Stdbk # 240) 1,160 kg (Berlin) and female Miadi (Stdbk # 398) even 1,200 kg when 11 years old (Washington). These data correspond to those obtained at Dvur Kralove Zoo.

Individual differences in size, thus weight, are significant, particularly in females; therefore, monitoring the weight of individual animals is important. If individual weights incl. changes are not known, this may cause a deficit of nutrition values within the administered diet. This was demonstrated in 1999 in Isis, who had a deficit of nitrogen in the ration, and because of the long duration of this, there was deterioration in male's condition and health problems. At the time of his greatest difficulties, unfortunately, the male was not weighed. After reviewing the diet and changes in feeding, both his health and condition returned to normal (see chart on page 124). It is possible that a similar deficit in the ration could result in weakening of the individual and the subsequent attacks by the infection and mortality (Elvira, Sali, Cody, Mabu, Sauron and Musso).

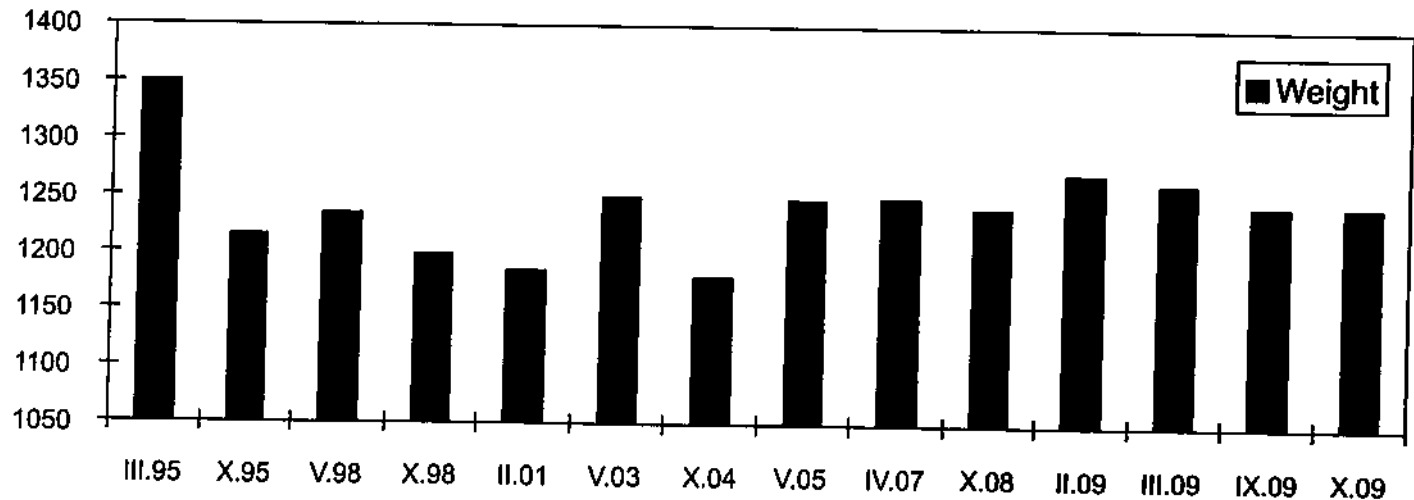
Weights of adult male black rhinos at Dvur Kralove Zoo prior to 31 December 2009

Male	Stdbk #	Weight (kg): min-max	Average (kg)	No. of measure- ments	Comments
Cody	260	1,060-1,140	1,088	4	Age 11-14 years
Isis	268	1,180-1,350	1,240	15	Age 17-32 years
Mabu	277	948	948	1	Poor condition
Jimm DK 3	283	1,000-1,058	1,028	4	Age 28-29 years
Eli DK 4	386	1,100-1,200	1,150	2	Age 6.5-8.5 years
Barlingo II	483	1,071-1,194	1,145.7	14	Age 13-17 years, 3 figures from Port Lymgne
Sauron DK 16	541	1,000	1,000	1	Weight at the time of death
Mweru	659	1,114-1,240	1,200	19	Age 5-13 years
Total	8 animals	948-1,350	1,099.5	60	
Control (ARKS)	3 animals	930-1,133	1,048	4	Chester, Washington

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

Female	Stalk #	Weight (kg; min-max)	Average (kg)	No. of measurements	Comments
Jimmi	175	915	915	1	Age 38 years
Elvira DK 1	244	668	668	1	Weight at the time of death
Sall DK 2	282	560	560	1	Weight at the time of death
Jessi DK 5	378	940-1,150	1,083	6	Age 11-25 years
Eimi DK 9	431	1,040	1,040	1	Weight at the time of death
Jaga DK 14	456	830	830	1	Age 5 years and 7 months - Port Lympne
Jiddah DK 17	540	923-980	952.5	60	Poor condition
Elba DK 19	619	1,019-1,096	1,057,5	1	Age 12-13 years
Musso DK 20	678	980	980	1	Age 3 years and 8 months
Jola DK 21	685	903-956	932.5	16	Age 11-12 years
Jane Lee DK 22	689	1,251-1,292	1,280	7	Age 11-12 years
Deborah DK 27	924	990-992	991,3	3	Age 4 years and 4-6 months
Malsha DK 28	965	1,099	1,099	1	Age 3 years and 11 months
Total	13 animals	560-1292	951.5	100	
Control (ARKS)	5 animals	762-1,200	1,012.5	6	Port Lympne, Whipsnade, Zurich, Berlin, Washington

Changes in weight in male Isis, 1995 through 2009



Body development

From the weight data obtained, weight gain during growth can be monitored, which was often more than 1 kg per day. In addition, we managed to get several birth weights that ranged from 23 to 48 kg in 7 individuals of both sexes; the average birth weight was 32.4 kilograms. Information on growth was obtained from 10 males and 15 females. Weight gain of growing calves is summarised in the following tables. Females usually attained adult weight between 4 and 5 years of age, while males reached the same between 5 to 6 years of age, which at the same time corresponds to reaching the sexual maturity.

Growth of calves

The male table includes 101 weighing data, of which 65 were found in weighing of eight adult males. Birth weight is based on 4 data from calves aged 1 to 3 days (Jos DK 7, Sauron DK 16, Jonas DK 18 and Davu), of which 1 figure was taken from Krefeld Zoo's data (Davu) and one case was a very weak calf, which the zoo ultimately failed to breed (Jonas DK 18). These data show the average birth weight of 32.75 kilograms. The data on growth of males are based mainly on figures obtained from 4 animals (Jabu DK 31, Jamie DK 29, Dzanty DK 33 and Davu); at the same time, they also include the individual weight figures from additional six males (Sado DK 6, Jos DK 7, Jacob DK 10, Jasper DK 11 and Sauron DK 16). Since the size is animal-specific, with males showing significant differences in adulthood, this fact is reflected in the submitted data as well, with Jamie DK 29 being the largest and Jos DK 7 the smallest of the young males, and Davu was the smallest out of those between 2 and 3 years of age.

Growth of male black rhinos at Dvur Kralove Zoo prior to 31/12/2009

Age	Weight span	Mean weight	Comments
Day 1 to 3	23-48 kg	32.75 kg	n = 4; 1 figure from Krefeld Zoo (Davu)
1 year	350-481 kg	415.5 kg	n = 2; 1 figure from Krefeld Zoo (Davu)
1 year and 2 months	561 kg	561 kg	
1 year and 5.5 months	668 kg	668 kg	
1 year and 6 months	535 kg	535 kg	
1 year and 6.5 months	680 kg	680 kg	
1 year and 8 months	728 kg	728 kg	
1 year and 10 months	690-775 kg	732.5 kg	n = 2
1 year and 10.5 months	786 kg	786 kg	
1 year and 11 months	800 kg	800 kg	
2 years	752-819 kg	785.5 kg	n = 2
2 years and 1 month	720 kg	720 kg	
2 years and 1.5 months	784 kg	784 kg	
2 years and 2 months	798 kg	798 kg	
2 years and 3.5 months	826 kg	826 kg	
2 years and 8.5 months	787 kg	787 kg	
2 years and 11 months	890-1,066 kg	978 kg	n = 2
3 years	864-1,122 kg	993 kg	n = 2

Age	Weight span	Mean weight	Comments
3 years and 1.5 months	800 kg	800 kg	
3 years and 2 months	909 kg	909 kg	
3 years and 2.5 months	1,146 kg	1,146 kg	
3 years and 3 months	1,155 kg	1,155 kg	
3 years and 4 months	927 kg	927 kg	
3 years and 5.5 months	965 kg	965 kg	
3 years and 7 months	973 kg	973 kg	
3 years and 8 months	972 kg	972 kg	
3 years and 9 months	994 kg	994 kg	
3 years and 10 months	1,017 kg	1,017 kg	
Adult	948-1,350 kg	1,009.5 kg	8 males; n = 65

The table for growth in females includes 144 weight figures, from which 100 were found in the weighing thirteen adult females (Jimmi, Elvira DK 1, Sali DK 2, Jess DK 5, Eimi DK 9, Jaga DK 14, Elba DK 19, Jiddah DK 17, Musso DK 20, Jola DK 21, Jane Lee DK 22, Deborah DK 27, Maisha DK 28, DK 15, Jiddah DK 17 and DK 25). The observed birth weight is based on data from 4 calves aged 1 to 4 days (Jaga DK 14, DK 15, Jiddah DK 17 and DK 25), while in two cases, the calf was a stillborn (DK 15 and 25), and another involved a weak and semi-hand-reared calf (Jaga DK 14). These data implicate the average birth weight of 30 kilograms. Growth figures in females are primarily based on data from 5 animals (Jaga DK 14, Jiddah DK 17, Deborah DK 27, Maisha DK 28 and Etosha DK 30). The highest weight - more than 1,000 kg - was reached by female Maisha when still less than 4 years old. The presented data therefore reflect variation in individual size due to the relatively small number of figures. The weight of adult females is influenced by the fact that the lowest weight figures were observed in older females at the time of death; as to healthy young females, Jaga DK 14 was the lightest animal with the weight of 830 kg as found at Port Lympne Zoo at the age of 5 years and 7 months.

Growth of female black rhinos at Dvur Kralove Zoo prior to 31 December 2009

Age	Weight span	Mean weight	Comments
Day 1 to 4	24-37 kg	30 kg	n = 4
Month 1	47 kg	47 kg	
Month 2	68.5 kg	68.5 kg	
Month 3	91 kg	91 kg	
Month 4	117 kg	117 kg	
Month 5	147 kg	147 kg	
Month 5.5	184 kg	184 kg	
Month 6	180-220 kg	200 kg	n = 2
Month 7	214 kg	214 kg	

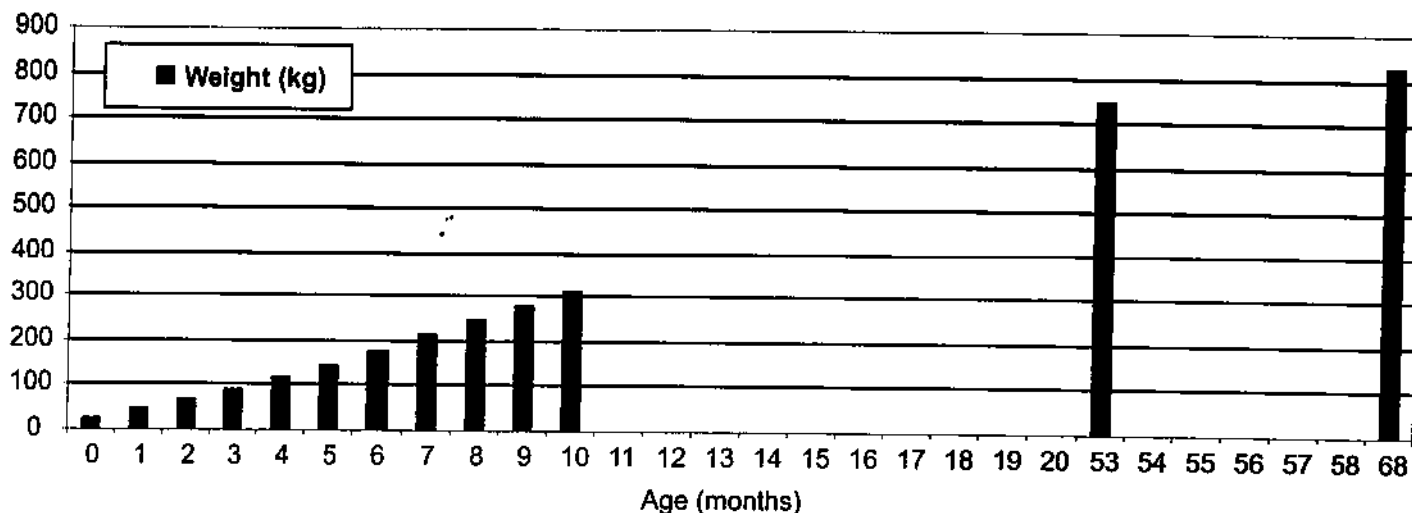
Age	Weight span	Mean weight	Comments
Month 8	249 kg	249 kg	
Month 9	280.5 kg	280.5 kg	
Month 9.5	298 kg	298 kg	
1 year and 1.5 months	510 kg	510 kg	
1 year and 5 months	592 kg	592 kg	
1 year and 6 months	510 kg	510 kg	
2 years and 2 months	765 kg	765 kg	
2 years and 4 months	720 kg	720 kg	
2 years and 5 months	843 kg	843 kg	
2 years and 7.5 months	865 kg	865 kg	
2 years and 9 months	889 kg	889 kg	
2 years and 10 months	895 kg	895 kg	
2 years and 11 months	725-954 kg	863 kg	n = 3
3 years	897 kg	897 kg	
3 years and 1 month	925-991 kg	958 kg	n = 2
3 years and 2 months	931 kg	931 kg	
3 years and 3 months	966-1,022 kg	997.7 kg	n = 3
3 years and 7.5 months	1,042 kg	1,042 kg	
3 years and 8.5 months	930-1,055 kg	992.5 kg	n = 2
3 years and 10 months	1,064 kg	1,064 kg	
3 years and 11 months	1,099 kg	1,099 kg	
4 years and 2.5 months	975 kg	975 kg	
4 years and 4 months	750-992 kg	871 kg	n = 2
4 years and 5 months	990 kg	990 kg	
Adult	560-1,292 kg	861.5 kg	13 females; n = 100

The following table (VONDRA *et al.* 1994, HOLECKOVA, 1995) as well as the graph show the growth of female Jaga DK 14, which was bottle-fed, thus regularly weighed up to near 10 months of age. The female above was measured at the age of 15.5 months together with Etna DK 13 of the same age. The table documents that these female did not differ in size, although one of them was reared solely by mother (Etna), while the other was largely bottle-fed (see hand-rearing chapter on page 132). The female growth chart has been compiled from data of six animals - Jaga DK 14, Jiddah DK 17, Musso DK 20, Deborah DK 27, Maisha DK 28 and Etosha DK 30. The last chart regarding growth summarises the weight data of female Jiddah DK 17, in which the following additional data has been obtained: birth weight (37 kg), weight at the age of 0.5 and 1.5 year and also extensive information at the age of 14-15 years. The chart records the variation in weight in adulthood.

Growth of the black rhino female Jaga DK 14 at Dvur Kralove Zoo

Age	Weight (kg)	Age	Weight (kg)	Age	Weight (kg)
Day 4	26.2	5 months	117	8 months	214
Day 33	47	Day 132	131	Day 225	224
2 months	68.5	6 months	147	9 months	249
Day 70	75.8	Day 163	162.5	Day 255	261
4 months	91	7 months	180	Day 275	280.5
Day 101	100.5	Day 192	192	Day 291	298

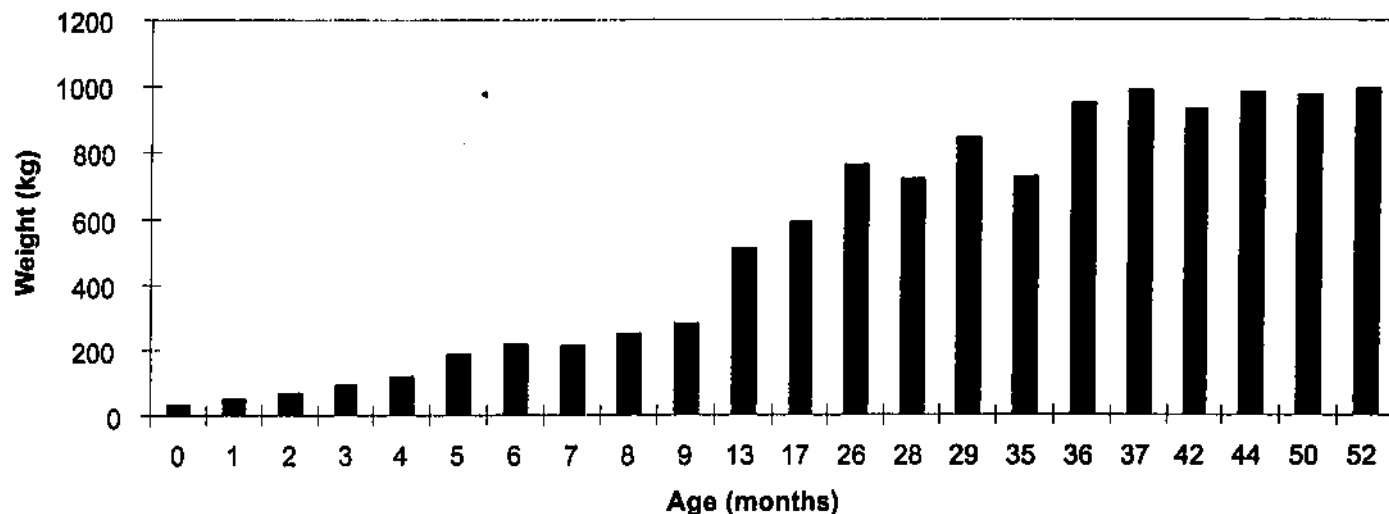
Growth of the black rhino female Jaga



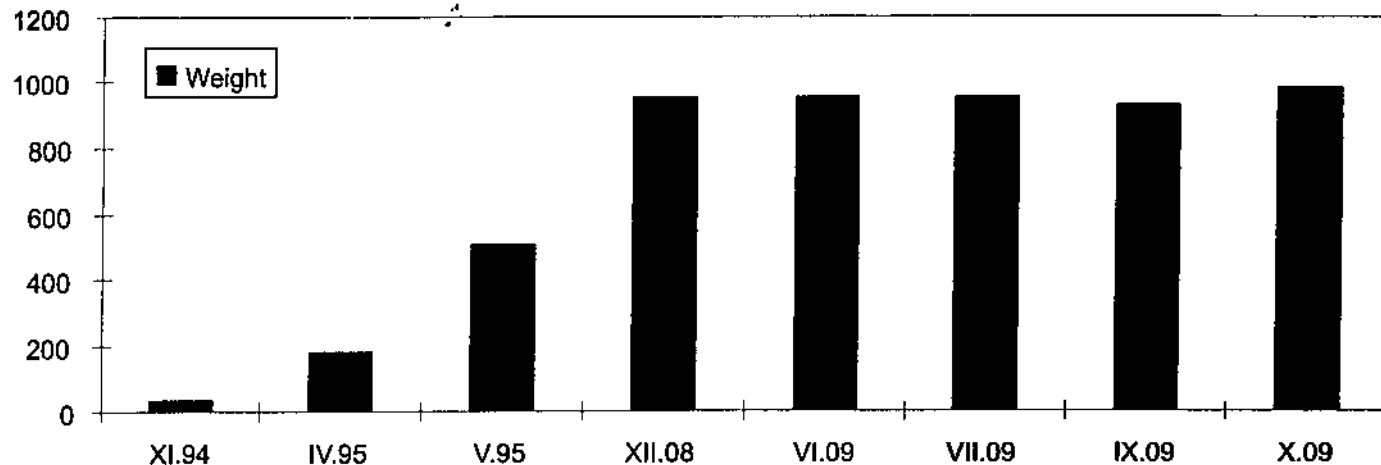
Comparison of sizes of young black rhino females at the age of 15.5 months

Body size	Jaga	Ema
Wither height	114 cm	112 cm
Body length excl. tail	291 cm	284 cm
Chest perimeter	202 cm	215 cm

Growth of black rhino females (n = 5) at Dvur Kralove Zoo prior to 31 December 2009



Growth and weight of Jiddah



Weight gain

Regular weighing of young rhinos successfully produced a number of data concerning weight increments during growth as contained in the tables on next page, which implies that the daily gains in both males and females are about 1 kg per day up to the age of 1 to 2 years; then the growth is getting slower with increments of about three quarters of a kilo per day and in the fourth year this declines to about half a kg per day. Growth is terminated between 4 and 5 years of age.

Weight gain in growing males at Dvur Kralove Zoo prior to 31 December 2009

Date	Age	Weight	Weight gain	Daily weight gain
Jos - M *21 May 1989 Dvur Kralove				
12 May 1989	Day 1	28 kg		
19 Nov 1990	1 year and 6 months	535 kg	+ 507 kg in 556 days	+ 0.91 kg/day
Davu - M *19 February 2006 Krefeld				
20 Feb 2006	Day 2	32 kg		
19 Feb 2007	1 year	350 kg	+ 318 kg in 365 days	0.87 kg/day
5 Nov 2008	2 years and 8.5 months	787 kg	+ 437 kg in 625 days	0.70 kg/day
10 Jun 2009	3 years and 4 months	927 kg	+ 140 kg in 190 days	0.73 kg/day
2 Dec 2009	3 years and 10 months	1,017 kg	+ 90 kg in 175 days	0.51 kg/day
Jamie - M * 2 January 2006 Dvur Kralove				
Birth weight	Estimation	45 kg		
27 Nov 2008	2 years and 11 months	1,066 kg	+ 1,021 kg in 1,059 days	0.96 kg/day
3 Apr 2009	3 years and 3 months	1,155 kg	+ 89 kg in 127 days	0.70 kg/day
Jasper - M * 13 September 1991 Dvur Kralove				
Birth weight	Estimation	35 kg		
6 Oct 1993	2 years and 1 month	720 kg	+ 685 kg in 753 days	0.91 kg/day
Jacob - M *23 June 1991 Dvur Kralove				
Birth weight	Estimation	35 kg		
23 May 1994	2 years and 11 months	890 kg	+ 855 kg in 1064 days	0.80 kg/day
Jabu - M * 1 February 2007 Dvur Kralove				
Birth weight	40 kg (estimated)			
30 Nov 2008	1 year and 10 months	690 kg	+ 650 kg in 667 days	0.97 kg/day
19 May 2009	2 years and 3.5 months	826 kg	+ 136 kg in 170 days	0.8 kg/day
Dzanty - M * 24 November 2007 Dvur Kralove				
Birth weight	Estimation	40 kg		
4 Dec 2008	1 year	481 kg	+ 441 kg in 375 days	1.18 kg/day
8 May 2009	1 year and 5.5 months	668 kg	+ 187 kg in 155 days	1.21 kg/day
24 Nov 2009	2 years	819 kg	+ 151 kg in 200 days	0.76 kg/day

Weight gain in growing females at Dvur Kralove Zoo prior to 31 December 2009

Date	Age	Weight	Weight gain	Daily weight gain
Jaga - F *14 December 1992 Dvur Kralove				
18 Dec 1992	Day 4	26.2 kg		
14 Mar 1993	3 months	91 kg	+ 65 kg in 85 days	0.76 kg/day
15 Jun 1993	6 months	180 kg	+ 89 kg in 93 days	0.96 kg/day
1 Oct 1993	9.5 months	298 kg	+ 118 kg in 108 days	1.09 kg/day
1 Oct 1993	Day 291 from birth	298 kg	+ 272 kg in 287 days	0.95 kg/day as of day four of age
21 Apr 1997	4 years and 4 months	750 kg	+ 452 kg in 1297 days	0.35 kg/day
26 Jul 1998	5 years and 7 months	830 kg	+ 80 kg in 461 days	0.17 kg/day
Sara - F * 24 February 1992 Dvur Kralove				
Birth weight	Estimation	30 kg		
5 Apr 1993	1 year and 1.5 months	510 kg	+ 480 kg in 405 days	1.19 kg/day
14 Jun 1994	2 years and 4 months	720 kg	+ 210 kg in 435 days	0.48 kg/day
Jiddah - F * 15 November 1994 Dvur Kralove				
15 Nov 1994	Day 1	37 kg		
30 Apr 1995	5.5 months	184 kg	+ 147 kg in 166 days	0.89 kg/day
14 May 1996	1 year and 6 months	510 kg	+ 326 kg in 379 days	0.86 kg/day
Deborah * 11 September 2004 Dvur Kralove				
Birth weight	Estimation	35 kg		
29 May 2008	3 years and 8.5 months	930 kg	+ 895 kg in 1,355 days	0.66 kg/day
10 Apr 2009	4 years and 6 months	992 kg	+ 62 kg in 316 days	0.20 kg/day
Maisha - F * 21 December 2005 Dvur Kralove				
Birth weight	Estimation	35 kg		
28 Jun 2006	6 months and 1 week	220 kg	+ 185 kg in 189 days	0.98 kg/day
12 May 2007	1 year and 5 months	592 kg	+ 372 kg in 318 days	1.17 kg/day
28 Nov 2008	2 years and 11 months	954 kg	+ 362 kg in 565 days	0.64 kg/day
21 Nov 2009	3 years and 11 months	1,099 kg	+ 145 kg in 358 days	0.40 kg/day
Etosha - F * 4 September 2006 Dvur Kralove				
Birth weight	Estimation	35 kg		
5 Nov 2008	2 years and 2 months	765 kg	+ 760 kg in 792 days	0.96 kg/day
10 Jun 2009	2 years and 9 months	889 kg	+ 124 kg in 217 days	0.57 kg/day
5 Dec 2009	3 years and 3 months	966 kg	+ 77 kg in 178 days	0.43 kg/day

HAND REARING

Artificial rearing was successfully carried out only once in the black rhino, in the years 1992-1993 (VAHALA *et al.* 1995, VONDRA *et al.* 1994). This involved female Jaga whose birth weight was only about 26 kg; this calf was the first young of the already 22-year-old female Jarca. The reason for the hand rearing was the fact that the calf was so weak that it could not stand while his mother produced little milk.

Because rearing problems had been expected, milk was collected from lactating females, in particular Sali and later on Eivira, and then frozen. The females were milked during the rearing period by keepers, who this way managed to gain and maintain in the frozen state about 3.5 litres of rhino milk. In cooperation with Hřebcín Slatinany (stud farm) where they keep the Kladruby white horse, about 8 l of frozen equine colostrum and milk had been prepared for the rearing.

After the birth, which took place smoothly, the keepers tried to help the calf to drink. Because these efforts were unsuccessful, the little Jaga was fed using a syringe 6 hours after birth with 20 ml of colostrum, which the keepers had obtained from Jaga's mother Jarca. This helped Jaga obtain the necessary immunity from her mother. However, as the calf was still unable to get up, it was fed from the bottle for calves for the first time three hours later (VONDRA *et al.* 1994). Jaga was drinking without problems and as mother Jarca was very quiet, the calf was hand-reared, separated from the mother only for drinking. Jarca was licking the calf, and at the same time, keepers were trying to put Jaga to her mother's udder throughout the first week of rhino's life, but milk was produced only from the left teat (VONDRA *et al.* 1994). Since another female - Elvira - gave birth at the same house only 6 days before Jarca and had enough milk, this female was milked by the keepers daily and small Jaga could be fed in part by rhino maternal milk up to day 50 of her age. At the same time, the keepers were trying to retain the lactation in Jarca and this female was milked periodically as well. During the rearing time, at least 25 l of milk from Jaga's mother Jarca and 70 litres of Elvira's milk could be obtained this way and administered to Jaga. Because the stock of the frozen milk was not any large, Jaga was given additional feeding consisting of the milk replacement based on the dried cow milk. The exact composition of the milk is shown in the following table.

Composition of milk for artificial rearing of the black rhinoceros at Dvur Kralove Zoo

Component	Quantity
Laktina	50 g
Glukopur	40 g
Germ oil	4 ml
Boiled water for bringing volume	To make up 1 litre
Calcium chloratum - once per day as of the day 5	1 coffee spoon
Combinal AD2 - once per day as of the day 5	1 ml
Combinal E - three times per week as of the day 5	0.2 ml

Because Jaga lived with her mother who produced the milk, she began to suck from the mother as well (VONDRA *et al.* 1994), first at the age of 20 days (3 Jan 1993), followed by daily drinking, which however probably made no more than 1-2 litres per day. From the month 4, Jaga was drinking only briefly; within the month 5, Jarca stopped lactating definitely, which was confirmed by the keepers on 23 May (VONDRA *et al.* 1994).

Hand rearing was carried out without any problems except for one brief diarrhoeic disease (26-27 February 1993), which was successfully handled using antibiotics (Chlamoxylin, Duon, Penicilin) and Carbosorb tablets. The physical development and use of prophylactic and medical preparations (VONDRA *et al.* 1994) is summarised in the following table. Jaga went out into the enclosure with her mother for the first time at the age of 3 months (VONDRA *et al.* 1994).

Treatment, prophylaxis and physical development of the black rhino Jaga at Dvur Kralove Zoo

Age (days)	Observations and actions	Comments
1	Showing attacks to the keeper by its immature horn	Natural action against the unknown
2	1st urination - 39 hrs after birth, 1st meconium - 40 hrs after birth	Meconium following massage of the rectum
3	Axelocal, Erevit, Selevit, juvenile arthritis serum	Prevention
7	Tetanus serum	Prevention
14	Juvenile arthritis serum; already regular defecation (once per day)	Prevention; throws faeces on a dung pile and poking them as her mother does
14-18	Duon, Ferridextran	Diarrhoea treatment
16	Tetanus serum	Prevention
31	Axelocal, Erevit	Prevention
42	Juvenile arthritis vaccine	Prevention
48	First evidence of grain feed intake (remnants after her mother)	31 Jan 1993
56	Juvenile arthritis vaccine	Prevention
60	Began take hay as a supplemental feed	12 Feb 1993
65	Began take carrots (unsliced)	17 Feb 1993
75-78	Chlamoxyf, Duon, Penicilin	Diarrhoea treatment - 5 days
86	Tetanus vaccine	Prevention
94	Outdoors with the mother for the first time	18 Mar 1993 at 14°C
107	Tetanus vaccine	Prevention
129	Leptospirosis vaccine	Prevention
150	Leptospirosis vaccine	Prevention
453	Weaned and separated from the mother; united with Etna	10 Mar 1994

Undoubtedly, such feeding was the foundation for successful artificial rearing. What's more, Jaga lived with her mother all the time, separated only for feeding. The very positive relationship between the keepers and Jarca played a vital role. In its 45 days of age, Jaga would drink 12 litres of milk per day, increasing her weight with 1 kg per day. The following preparations were added to the milk: Calcimag and Glyphostan from the day 58 over the period of 2 months and Vubimag and Farmaferr from the day 97 up to weaning in the month 15.

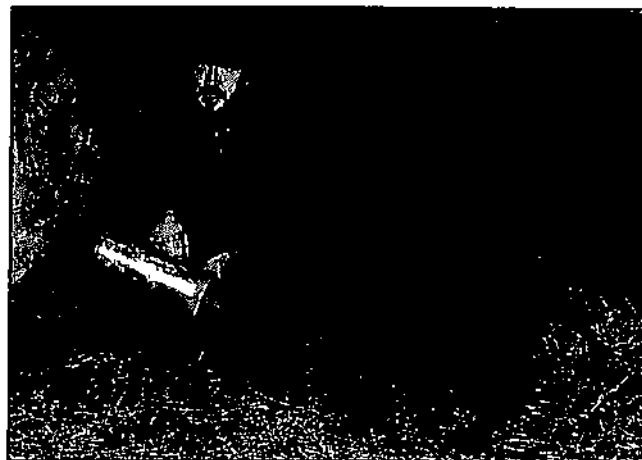
Jaga was fully weaned in the month 15 of her age - on day 453 (10 March 1994), fed with 3.5 litres of milk for the last time, and separated from the mother. At the same time, she was united with the daughter of Elvira, which was female Etna, only 6 days old. The original intention to continue on Jaga's bottle-feeding was cancelled because Etna also wanted her bottle of milk (VONDRA *et al.* 1994). At the time of weaning, both females were about the same size, which is suggested by their physical dimensions obtained on 1 April 1994 (more details are available in the table - VONDRA *et al.* 1994).

Jaga was weighed from day 4 up to 291, when her weight was already 298 kg. The following chart shows the growth of Jaga and is supplemented by the data obtained in her adulthood at Port Lympne Zoo, England (ARKS).

At the end of her second month, Jaga kept growing 750 g per day; in month 3 to 5 it was 0.9 kilograms per day, and later until the end of weighing (after 9 months of age) it was nearly 1 kg per day (VONDRA *et al.* 1994).

As part of prevention, Jaga was administered with the following: juvenile arthritis serum (day 3 and 14), tetanus serum (day 7 and 16), juvenile arthritis vaccine (day 42 and 56), tetanus vaccine (day 86 and 107) and leptospirosis vaccine (day 129 and 150).

The second Jarca's young - male Jonas - was born very weak. Jonas weighed only 23 kg and unfortunately was even unable to stand, unlike Jaga. Despite all efforts we failed to keep him alive and the male died when 8 days old, weighing 25 kg.



Zdenek Vondra bottle-feeding Jaga DK 14 (zc)

The composition of maternal milk in the black rhinoceros (VAHALA 1995, GOLTENBOTH *et al.* 1995):

	Details not specified	Jarca, lactation day 57	Elvira, lactation day 66	Lactation month 19	Lactation day 30-330	Replacement milk in DK
Dry matter		9.3%	10.18%	8.1%	8.8%	8.73%
Fat	3.2%	1.3%	2%		0.2%	0.3%
Lactose	4.7%	8.29%	6.83%	6.06%	6.6%	8.43%
Protein	3.3%	0.986%	1.033%	1.54%	1.4%	1.452%
Ashes		0.451%	0.493%	0.34%	0.3%	0.625%
Ca		0.53%	0.49%	0.06%		0.36%
pH		6.3	6.0			6.4

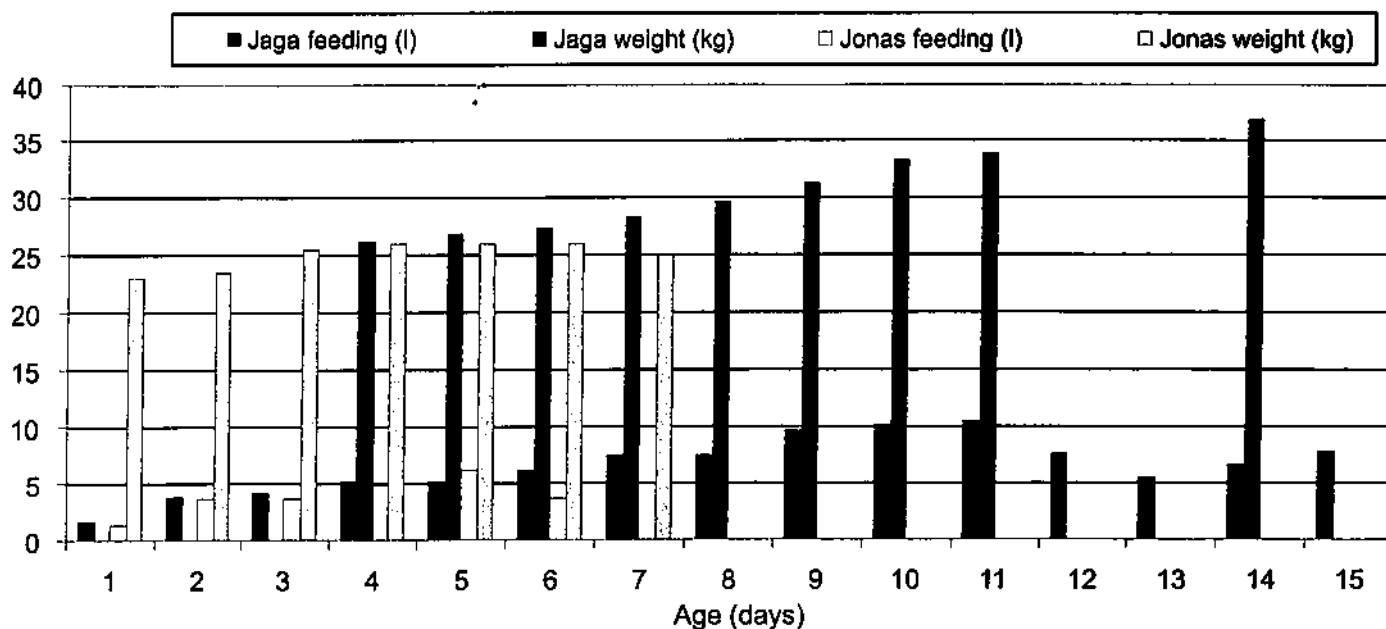
Diet composition of the black rhino Jaga until 60 days old

Milk/Day	1.	2.	3.	4.	5.	10.	15.	20.	25.	30.	35.	40.	45.	50.	55.	60.
Rhino milk Elvira	730	1,690	410	1,350	1,720	3,370	1,800	780	1,710	1,640	650	1,600	1,710	1,400	-	-
Rhino milk Jarca	20	345	690	520	860	1,050	540	200	610	580	600	100	200	350	70	-
Rhino milk Sali	450	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Horse colostrum	530	1,690	2,900	1,875	875	-	-	-	-	-	-	-	-	-	-	-
Replacement milk	-	-	120	1,505	1,750	5,700	5,510	7,020	7,280	8,080	7,650	10,030	10,140	11,210	13,700	13,800
Total (ml)	1,730	3,805	4,120	5,269	5,205	10,120	7,880	8,000	8,600	10,300	8,900	11,730	12,080	12,960	13,770	13,800

Information on bottle-feeding of the black rhino Jaga (VAHALA *et al.* 1995, VONDRA *et al.* 1994)

Age	Feeding interval/time	Night break	Dose per feeding	Number of feedings	Drunken quantity per day
Day 1	60-90 min	2.5 hrs - before the dawn	As required by Jaga	Since 9 am 8	1.73 l
Day 2-9	1.5 hrs	4 hrs (12 pm - 4 am)	270-370 ml	11	3.8-9.75 l
Day 10	2 hrs	4 hrs (12 pm - 4 am)	1,400 ml	9	10-11 l
Day 30 to 60	2.5 hrs	6 hrs (12 pm - 6 am)	1,400-2,000 ml	7	10-14 l
Month 2 to 6	3.5 hrs	8 hrs (10 pm - 6 am)	3,000 ml	5	15 l
Month 6 to 10	3.5 hrs	-	3,000-3,500 ml	4	12-14 l
Month 11	8 am, 2 pm, 7 pm	-		3	10 l
Month 13 to 14	9 am, 3 pm	-	3,500 ml	2	7 l
Month 15	12 am		3,500 ml	1	3.5 l

Feeding and growth of bottle-fed black rhinos Jaga and Jonas



Changes in the composition of maternal milk during lactation

In 2006, following the first birth given by a very quiet female Musso (21 December 2005), we managed to obtain milk samples for analysis, taken regularly every week over the period of 3.5 months (from 16 January to 26 April 2006). The laboratory analysis of the samples was carried by EKO-LAB Zamberk; the data obtained are summarised in the table.

Changes in the composition of maternal milk in female Musso, Dvur Kralove Zoo, in 2006

Sampling date	Lactation day	Dry matter (%)	Ash (%)	Fat (v/v)	Lactose (%)	Milk protein (%)
16 Jan	26	10.46	0.24	2.0	5.86	1.76
23 Jan	33	9.36	0.21	0.40	7.17	1.54
30 Jan	40	8.86	0.16	0.50	6.80	1.80
January (mean)		9.56	0.20	0.97	6.61	1.70
6 Feb	47	8.55	0.15	0.30	6.75	1.78
13 Feb	54	9.19	0.01	0.50	7.25	1.30
20 Feb	61	8.71	0.11	0.50	7.17	1.36
27 Feb	68	8.77	0.03	0.50	7.48	1.51
February (mean)		8.81	0.08	0.45	7.16	1.49
8 Mar	77	8.85	0.01	1.00	5.99	1.37
13 Mar	82	8.72	0.06	0.80	5.83	1.29
20 Mar	89	8.39	0.12	0.50	5.83	1.14
29 Mar	98	8.69	0.13	0.40	6.07	1.30
March (mean)		8.66	0.08	0.68	5.93	1.28
5 Apr	105	9.17	0.13	0.70	5.96	1.51
10 Apr	110	8.68	0.10	0.40	6.28	1.46
20 Apr	120	8.60	0.09	0.70	6.44	1.13
26 Apr	126	7.94	0.15	0.60	6.40	1.05
April (mean)		8.60	0.12	0.60	6.27	1.29

Maximum longevity

At Dvur Kralove Zoo, female Jimmi, a wild-caught rhino from Kenya, achieved the highest age, i.e. more than 39 years. Males Isis (born more than 32 years ago in the U.S.) and Jimm (born over 29 years ago in Dvur Kralove) are still alive. Information about the oldest animals is summarised in the table. The highest age recorded in black rhinos in captivity from 1956 to 1990 was 45 years in one of females and 36 in one of males (KLOS and FRESE 1991). At Detroit Zoo, the U.S., wild-caught male Rudy was euthanised in 2001 at the age of 49 years (FRADRIC and OCHS 2001). JONES (1993) gives the highest recorded age at the eastern black rhinoceros in captivity: 45 years and 10 months (the animal died in 1980). According to the International Studbook (GOLTENBOTH and OCHS 1997), the oldest males that lived in 1996 were 44-46 years, while in females the oldest age category was 40-42 years.

Maximum longevity in black rhinos at Dvur Kralove Zoo prior to 31 December 2008

No.	Name	Sex	Date and place of birth	Date of death	Age
7/7/DK/0	Jimmi	F	February 1970, Kenya	21 Aug 2009	39 years and 6 months
16/14/DK/0	Isis	M	7 Nov 1977 Cincinnati, US	Alive	32 years and 2 months
17/0/DK/3	Jimm DK 3	M	18 Mar 1979 Dvur Kralove	Alive	30 years and 9.5 months
15/0/DK/2	Sail DK 2	F	5 Jul 1978 Dvur Kralove	25 Feb 2006	27 years, 7 months and 22 days
10/10/DK/0	Jarca	F	February 1970 Kenya	8 Sep 1990	26 years and 6 months
19/0/DK/5	Jessi DK 5	F	8 Dec 1984 Dvur Kralove	Alive	25 years and 1 month
29/15/DK/0	Cody	M	20 May 1975 Sydney, Australia	19 May 1999	23 years, 11 months and 29 days
14/0/DK/1	Elvira DK 1	F	2 Oct 1977 Dvur Kralove	25 Feb 1996	18 years, 4 months and 23 days
30/16/DK/0	Mabu	M	23 Jan 1979 Magdeburg, Germany	11 Apr 1994	17 years, 8 months and 26 days



Jimmi, 39 years and 3 months old, on 16 May 2009 (dh)

Nutrition and feeding

In terms of zoo husbandry, the black rhinoceros is a food specialist that feeds particularly on leaves of various shrubs and herbs, and occasionally grass. Therefore, determining a correct diet is the most critical and also most difficult in breeding this species. Moreover, there are considerable animal-specific differences in size and the correct estimate of the individual weight without the use of scales is very difficult.

Feeding black rhinoceroses has evolved considerably at Dvur Kralove Zoo through a number of changes during the breeding history. Following the young rhino imports from the wild up to their adolescence, there were in fact no difficulties in rhino management. The basic components of feeding over the years are summed up in the following tables. Water was available to animals in every type of diet.

1971 diet		1972 diet	1973 diet	1974-1976 diet
Young	Sub-adults			
Mush; twice per day	Maize	Hay - ad libitum	Hay - ad libitum	Hay - ad libitum (Except summers since 1975)
Pellets (inc alfalfa pellets)	Pellets - 1 kg/animals (incl. alfalfa pellets)	Summers: Grass; sometimes alfalfa and clover	Summers: Grass Winters: Carrots	Summers: Grass
Milk	Milk - 3 l/animal	Alfalfa pellets Pellets	Alfalfa pellets VD-P2 pellets	Pellets
Glukopur	Oats	Milk	Dried milk	Dried milk
Alfalfa hay - ad libitum		Sugar-beet pomace, 3 times per week	Oats	Sugar-beet pomace
Winters: Carrots, 2-4 times per week Sugar-beet pomace, 2-4 times per week		Carrots, once per week	Bread	
Summers: Browse, 2-4 times per week		Pre-germinated cereals, once per week	VITASA, salt	Winters: Daily - apples, pears, carrots
		From time to time: Mash, VITASA, glucose, beet, salt	Browse	Browse Winters: Sometimes browse and fresh-frozen twigs

From July 1975, the summer diet was simplified to concentrated feedstuffs, browse and green fodder. From July 1976, the summer ration was again simplified to concentrated feedstuffs, green feed and browse. In January 1977, the basic diet composed of hay, concentrated feedstuffs, browse and preserved twigs, sometimes accompanied by carrots, apples and beets. In summer, grass was fed alongside seasonal fruits and vegetables, like cucumbers, Savoy cabbage, tomatoes, cabbage, cauliflower, apples, pears and plums). The oversimplification of the ration could probably have an effect on worsening health in adolescent black rhinos. In terms of management, the rhinos lived in their own house, and the space conditions could be considered better than ever before. The more surprising was the unexpected death of the first breeding female Elsa in April 1978, who then nursed her six-month calf.

In the second half of 1978, after the death of another female (Zina), the diet of all animals was completely changed, and the then served concentrated feed was replaced with other types of feedstuffs, which had proved following the arrival of the black rhinos in the early 1970s.

After the death of Ken in November 1979, there was another change in diet, now consisting of hay, oats, vegetables, browse, clay with sea salt and Plastin, ground maize, VITASA and browse twice a week.

The following table documents the difference in the diet of the lactating female Elsa (died on 7 April 1978) and Jimmi, who survived almost 40 years.

Comparison of the diet of two female black rhinoceroses at Dvur Kralove Zoo

Elca + Elvira DK 1 (born 1977)	Jimmi + Jimm DK 3 (born 1979)
Concentrated feedstuffs	Concentrated feedstuffs 15 l/day
Dried milk - only 3 Oct to 22 Nov 1977 and from 20 Dec to January 1978	Dried milk - 1.5 l/day
Fruits - plums, pears, apples, bananas	Fruits and vegetables - 20 l/day
Vegetables - cabbage, Savoy cabbage, celery, peppers, cauliflower, carrots, root parsley	Rice mash - 3 l/day
Green fodder in summer; hay only in winter	Hay - ad libitum
D.C.F. - from time to time	Yeast
Glukopur - from time to time	Salt
As of 22/12/1978: vitamin treatment as follows: B-komplex 1 spoon/day Celaskon - 1 spoon/day Ferronat 10 tablets/day	Farmaferr 10 tablets/day

In the late 1970s and early 1980s, with regard to several deaths of adult black rhinos, a number of dietary components were experimentally tested and diet composition evaluated, resulting in a formulation of pellets developed by the Dvur Kralove Zoo research institute, called ZOO A and ZOO B pellets (SPALA 1986). The modification of the diet in the 1980s are summarised in the following table.

Comparative overview of black rhino diets at Dvur Kralove Zoo in the 1980s

1980 diet	1982 diet	1986 diet
Hay - ad libitum	Hay - ad libitum	Hay - ad libitum
MKP pellets	Oats - 6 l/animal/day	Summers - grass (green fodder)
Rice mash	Crushed oats - 2.3 l/animal/day	ZOO A pellets - 1.3 measur. cup ZOO B - 1.4 measur. cup
Apples, sometime lemons, fruit pomace	Alfalfa pellets - 1.6 l/animal/day	Oats - 4.9 measur. cups
Celery, root parsley, kohlrabi, giant kohlrabi, sometimes carrots, onions, leeks, cauliflower, peppers, tomatoes, cucumbers, potatoes, cabbage, Savoy cabbage, red beets	Vitasa - 3 spoons/animal/day Farmaferr - 3 spoons/animal/day	VITASA - 10 spoons Farmaferr - 2 spoons
From time to time: ground or crushed barley, alfalfa pellets, oats, Solamyl, bran, Hippovit, bread, brewer's yeast	Apples, cabbage, onions, red beet, celery Carrots in winter Summers - green fodder	Browse
Temporarily: Plastin, marine salt, clay, Glukopur, Farmaferr	Browse	Nursing females: dried milk
Browse	Nursing females: dried milk	

An integral part of the black rhino diet is browse, which since 2002 has been served inside the enclosure in upright position, i.e. the branches are mounted in brackets embedded in the ground to simulate the real bush. At the same time, such feeding is a part of rhino enrichment (TOMASOVA 2004).

Fundamental reassessment of diets took place in 1999, when the condition of Isis was so poor that the male's death was expected. Because the rhino was only 18 years old and thin-bodied, his ration was recalculated and found to have a deficit of about 14% nitrogen substances (PTACKOVA - pers. comm.) against the male's weight. Subsequent inspection revealed that males and females without calves were the most lightweight, which could be because offspring and pregnant and nursing females were provided with added milk powder and other feeding improvements. Because a good condition was known to be that of the rhinos based in Port Lympne, London and Berlin, those zoos were contacted and diets compared. The diet was subsequently modified, and the condition of females without calves and males improved. The diet has since included bananas, potatoes, etc. Isis got better, but Elvira, less than 19-year-old female, died. Because at that time it was already discussed that very similar symptoms as those of haemolytic anaemia, which our animals suffered particularly in the past, can be assigned to the excess of iron, which used to be served to suppress haemolytic anaemia), samples of Elvira's organs were sent for testing whether they contained iron or not. As it turned out, Elvira had haemosiderosis of all organs (iron-containing medications began to be administered in the late 1970s), and therefore all supplements containing iron were excluded from the diet. In 2002 and 2003, four animals were treated with potassium humate, which was intended to help flushing iron from the body based on colloidal minerals. These involved males Isis and Jimm, and females Jimmi and Eimi. The treatment consisted in administering 1 tablespoon of the solution in bread 3 times a day for 3 weeks, one-week break and another three weeks of administration. Male Isis completely recovered and became a father again in 2007. Unfortunately, female Eimi died unexpectedly of bacterial infection in 2004, while examination of organs showed continuing haemosiderosis. Eimi's death was sudden and surprising, because the female had a very good physical condition, weighing more than a tonne. The remaining three animals became the oldest ones in the breeding history. Unfortunately, organ haemosiderosis turned out to be the cause of death of Sauron, a relatively young male (less than 13 years) in 2007, and therefore we proceeded to the potassium humate treatment on the remaining rhinos, who had been using Ferrone in the past (i.e. until 2001). Determining whether iron had been flushed from organs or not is difficult in live animals. As a result of age, female Jimmi was euthanised in August 2009, where organ examination revealed that haemosiderosis did persist. Thus, the positive impact of colloidal minerals cannot be clearly demonstrated, although some toxins and iron might have been flushed to some extent (VAHALA pers. comm.).

The change in the pelleted feed in recent years was also of great importance - at first, black rhinos were fed with two types of pellets according to the formula developed directly at Dvur Kralove Zoo (SPALA 1986) and called ZOO A, B and C, which were supplemented with Mazuri pellet feeds over a short period. Currently, rhinos obtain ungulate pellets called ZOO A (manufacturer: De Heus, Bucovice, CR) and rhino pellets called KWANU (manufacturer: FeedNatur Brno, CR) in line with nutritional requirements of the Dvur Kralove Zoo Nutrition Department (PTACKOVA pers. comm.). Nutritional composition of the pellets is presented in the following table.

Nutritional values of pelleted feeds in black rhino feeding at Dvur Kralove Zoo (PTACKOVA 2009)

Pellets/contents	ZOO A	KWANU
Nitrogen substances (N)	155.32 g/kg	130 g/kg
Fat	51.28 g/kg	28 g/kg
Fibre	136.43 g/kg	140 g/kg
Vitamin A	41,221 IU/kg	8,500 IU/kg
Vitamin E	120.10 IU/kg	2,000 IU/kg
Calcium (Ca)	16.95 g/kg	12 g/kg
Sodium (Na)	1.53 g/kg	1.7 g/kg
Phosphorus (P)	12.26 g/kg	8 g/kg

The basis of feeding black rhinos now is quality grass hay including alfalfa hay, supplemented by meadow grass and fresh alfalfa in summer. The basic ration is shown in the following table. In the winter, carrots are fed instead of grass. From spring to autumn, browse is made available from willow, fruit trees, etc. In winter, wheat germs are fed. In summer, Inulin is administered (10 g/animal/day). In nursing females and growing calves, limestone (45 g/animal/day) and skimmed milk powder (0.6 kg/animal/day) is added into the diet.

Base diet of the black rhinoceros at Dvur Kralove Zoo in 2009 (PTACKOVA 2009)

	Hay Grass	Pallets ZOO A	Pallets KWANU	Oats crushed	Ground barley	Bread	Apples	Bananas	Vegetab- les	Inulin
Male	Ad libitum	2 kg	2 kg	0.3 kg	0.15 kg	1 kg	3 kg	2 kg	5 kg	0.05 kg
Female	Ad libitum	1.3-1.7 kg	1.3 kg	0.3 kg	0.15 kg	1 kg	2 kg	1-2 kg	4 kg	0.05 kg

The diet includes the following supplements: torula 0.1 kg/animal/day, olive oil 0.02 l/kg/animal/day, feeding salt 3 g/kg/animal/day (i.e. 1 teaspoon/week), C - Compositum 10 g/animal/day, and vitamins A, B and E once per month.

Health issues

Throughout the years, internal and external parasites were not an issue in rhinos, except for the period immediately after the arrival from the wild (STEHLIK 1979). There were rare cases of slight tapeworm invasion throughout the years, with the *Anoplocephala* genus responsible (VAHALA pers. comm.). The fundamental problem in the black rhino is that they tend to suffer haemolytic anaemia in captivity. Following the deaths in connection with the disease above in the late 1970s, iron-containing preparations were included in the diet, as animals were showing low blood levels of red blood cells and haemoglobin both throughout and after the period of disorder. As red blood cells disintegrate, iron is flushed into the body and stored in organs in the form of haemosiderine. When dead animals were eventually examined, haemosiderosis confirmed in all organs and excess of iron in the diet found to even intensify storage of surplus iron in tissues - thus increasing haemosiderosis in organs, the zoo ceased to include iron in the diet; indeed, efforts followed to flush iron from the organs using colloidal minerals. When the condition of the animals was worsening, this was usually manifest as a bleeding tail tip and peeling skin. Exposing animals to the UV lamps installed inside the house for about 1 hour per day especially in winter has had a positive effect on the skin. Female Sali DK 2 suffered bloody mucosal erosions in the mouth a number of years, which was treated using a range of ways, with applied high doses of vitamin C eventually proving to be the most effective. In one of the cases, surgery of a purulent molar abscess was performed (Jimm DK 3). The factors having an impact on the deterioration in the condition of animals included diet, especially if animals' weight was not well monitored, but rather only estimated. In one case (Isis), the imbalance of the diet was established because the male suffered around 1999 from worsening condition, skin problems including the tip of the tail, and following a change in feeding and repeated administration of colloidal minerals his condition returned to normal and the accompanying health problems disappeared. Because black rhinos tend to be significantly nervous animals, a preventive calming by Diazepam is practiced, especially at a time before transport or transfer and capture.

The following table lists the causes of deaths as recorded in the post mortem reports (VAHALA 2009). The causes of deaths include age, repeated haemolytic anaemia, pneumonia including fungal pneumonia and kidney failure. A negative role in the deterioration of even relatively young animals might probably be played by haemosiderosis of organs and possibly in some cases, the imbalance of the diet as well. Two cases of mortality occurred in connection with anaesthetising rhinos using Immobilon: male King suffered intestinal volvulus, which occurred following a transfer of the narcotised animal; the second case was heart failure in female Satara once the animal entered the state of narcosis (VAHALA pers. comm.).

According to the International Studbook data for the years 1956-1990, deaths were recorded throughout the year with a maximum in January and December (KLOS and FRESE 1991).

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

No	Name	Sex	Died	Age	Cause of death
6/6/DK/0	Elsa	F	7 Apr 1978	7 years	Haemolytic anaemia
4/4/DK/0	King	M	22 Apr 1978*	7 years	Died following immobilization - intestinal volvulus
9/9/DK/0	Tuty	F	24 May 1978	7 years	Haemolytic anaemia
5/5/DK/0	Zina	F	26 Jun 1978	8 years	Haemolytic anaemia
2/2/DK/0	Ken	M	8 Nov 1979	9 years and 9 months	Haemolytic anaemia, mediocalcinosis, haemosiderosis of all organs
13/13/DK/0	Satara	F	24 Apr 1981	7 years	Died during immobilization - heart failure, haemosiderosis of all organs
31/0/DK/15	—	F	11 Apr 1994	0	Premature birth - stillborn on day 427 of pregnancy, 24 kg
35/0/DK/18	Jonas	M	12 Dec 1995	8 days	Pneumonia - in hand rearing
14/0/DK/1	Elvira	F	25 Feb 1996	18 years and 5 months	Pneumonia - pulmonary mycosis - Aspergillus, aortic mediocalcinosis, haemosiderosis of all organs
10/10/DK/0	Jarca	F	8 Sep 1996	26 years and 6 months	Mycotic pneumonia, mediocalcinosis, haemosiderosis of all organs
30/30/DK/0	Mabu	M	19 Oct 1996	17 years and 9 months	Pneumonia, mediocalcinosis, haemosiderosis of all organs
29/29/DK/0	Cody	M	19 May 1999	24 years	Pneumonia, nephritis, enteritis
43/0/DK/25	—	F	24 Aug 2002	0	Stillborn, complicated birth
23/0/DK/9	Elmi	F	14 May 2004	13 years and 9 months	Bacterial infection, haemosiderosis of organs
33/4/DK/0	Sali	F	25 Feb 2006	27 years and 8 months	General exhaustion, aortic mediocalcinosis, haemosiderosis of all organs
37/0/DK/20	Musso	F	14 Jul 2007	9 years and 11 months	Mycotic pneumonia, colic, haemosiderosis of all organs
50/0/DK/32	—	M	22 Sep 2007	0	Abortion
32/0/DK/16	Sauron	M	24 Sep 2007	12 years and 11 months	Purulent pneumonia, mediocalcinosis, organ dystrophy, haemosiderosis of all organs
7/7/DK/0	Jimmi	F	21 Aug 2009	39 years	Euthanised for age, unable to stand up
33/0/DK/17	Jiddah	F	25 Dec 2009	15 years	Euthanised while in agony - kidney failure

Exports of black rhinoceroses

Throughout the breeding history, 23 (13.10) black rhinos have been exported from the zoo, where 6 (3.3) individuals were wild caught and the remaining 17 (10.7) were born at Dvur Kralove Zoo; this included 3 (2.1) individuals shipped to the USA, 17 (9.8) distributed around Europe and 3 (2.1) reintroduced to the country of origin - Tanzania. More details are included in the following table.

Overview of black rhino exports from Dvur Kralove Zoo prior to 31 December 2009 (M - male, F - female)

No	Sex	Name	Stdbk #	Departure	Born	Arrival	Comments
1	M	Lord	169	22 Jun 1972 Jacksonville, USA	January 1970, Kenya	22 Aug 1971 Kenya, wild-caught	Died 1999; number of descendants: 1.3
2	F	Lenka	176	22 Jun 1972 Jacksonville, USA	1970 Kenya	22 Aug 1971 Kenya, wild-caught	Died in 1982 without offspring
3	M	Addo	216	20 Apr 1976 Lesna, CR	1971 Kenya	2 Jul 1974 Kenya, wild-caught	Died in 1978 without offspring
4	F	Satara	218	20 Apr 1976 Lesna, CR	1973 Kenya	2 Jul 1974 Kenya, wild-caught	Died in 1981 without offspring
5	M	Murray	171	29 Oct 1980 Wroclaw, Poland	February 1970, Kenya	22 Aug 1971 Kenya, wild-caught	Died in 2009, number of descendants: 1.0
6	F	Sabi	217	23 Apr 1983 Zurich, Switzerland	1972 Kenya	26 Jun 1974 Kenya, wild-caught	Died in 2008; number of descendants: 2.1
7	M	Sado	388	18 Oct 1989 Atlanta, USA	26 Aug 1986 Dvur Kralove	Reared in DK	Lives in Atlanta Zoo (local name: Boma)
8	M	Jos	391	19 Nov 1990 London, UK	21 May 1989 Dvur Kralove	Reared in DK	Died 2004; number of descendants: 0.1
9	F	Sany	417	4 Sep 1991 Hannover, Germany	1 Oct 1989 Dvur Kralove	Reared in DK	Number of descendants until 2005: 1.2
10	M	Eli	386	1 Oct 1992 Magdeburg, Ger.	15 May 1984 Dvur Kralove	Reared in DK	Died 1995; number of descendants: 1.1
11	M	Jasper	450	6 Oct 1993 Leipzig, Germany	13 Sep 1991 Dvur Kralove	Reared in DK	Exchanged with Berlin for female Nane on 1 Oct 1993 Number of descendants until 2004: 1.4
12	F	Nane	437	23 May 1994 Krefeld, Germany	4 Apr 1991 Berlin, Germany	Never arrived, the exchange was carried out through contracts	Obtained based on an exchange with Berlin Zoo; never arrived in Dvur Kralove, the mother of Davu (Stdbk # 970)
13	M	Jacob	438	24 May 1994 Krefeld, Germany	23 Jun 1991 Dvur Kralove	Reared in DK	Until 2005 without offspring
14	F	Sara	481	14 Jun 1994 Leipzig, Germany	24 Feb 1992 Dvur Kralove	Reared in DK	Died 2001; number of descendants: 1.1

No	Sex	Name	Stdbk #	Departure	Born	Arrival	Comments
15	F	Etna	455	16 Nov 1995 Port Lympne, UK	8 Dec 1992 Dvur Kralove	Reared in DK	Number of descendants after 2005: 1.1
16	F	Jaga	456	11 Nov 1999 Port Lympne, UK	14 Dec 1992 Dvur Kralove	Reared in DK	Number of descendants until 2005: 1.0
17	F	Salome	762	26 Nov 2001 Port Lympne, UK	25 Jan 2000 Dvur Kralove	Reared in DK	Had one calf in 2009
18	M	Jeremy	857	11 Apr 2005 Chester, GB	25 Jan 2000 Dvur Kralove	Reared in DK	In 2005 moved to France, in 2009 to Zurich
19	F	Ema Elsa	898	11 Apr 2005 Chester, GB	2 Nov 2002 Dvur Kralove	Reared in DK	Loan, exchanged for her first daughter in 2009 (Bashira)
20	M	Jimmi	283	21 Aug 2007 Zurich, Switzerland	18 Mar 1979 Dvur Kralove	Reared in DK	Moved back to Dvur Kralove on 16 May 2008
21	F	Deborah	924	27 May 2009 Mkomazi NP, Tanzania	11 Sep 2004 Dvur Kralove	Reared in DK	Arrival in Mkomazi NP on 29 May 2009
22	M	Jamie	976	27 May 2009 Mkomazi NP, Tanzania	2 Jan 2006 Dvur Kralove	Reared in DK	Arrival in Mkomazi NP on 29 May 2009
23	M	Jabu	986	27 May 2009 Mkomazi NP, Tanzania	1 Feb 2007 Dvur Kralove	Reared in DK	Arrival in Mkomazi NP on 29 May 2009
In total, 23 (13.10) individuals were exported, of which 3 (2.1) were returned to the wild in Africa.							

Summary

Breeding black rhinos began by capturing juvenile animals in Kenya in 1971, when first ten (4.6) animals were imported from Tsavo National Park, from which a pair was supplied to Florida (USA) a year after. In 1974, additional trio (1.2) was imported from Kenya; in the same year, 4 (2.2) animals left to Wroclaw (Poland), Zurich (Switzerland) and Lesna Zoo in Moravia (CZ). In the beginnings, the animals were managed without any problems, staying together, which was the reason why the father of the first calf born in 1977 was unknown because the mother had been mated by two males kept within the same herd. More two calves were born in 1978 and 1979, respectively. From 1978 to 1981, 5 (2.3) rhinos died, including both adult males. This interrupted the series of successful breeding for 5 years, as the new male, which was obtained from the U.S. in 1983 had yet to reach adulthood. Since 1984, there were already regular births; a total number of rhinos born for the entire period of holding was 35 (13.22) animals, of which three (2.1) were born dead and 31 (11.20) calves were successfully reared. In May 2009, a trio (2.1) of juveniles was reintroduced to Mkomazi National Park, Tanzania, which is a part of the Tsavo Ecosystem. Summary data for each year are shown in the following table.



A group of black rhinos, 24 August 1983 (th)

Numbers of black rhinos at Dvur Kralove Zoo in the years 1971-2009 (1.0 - male, 0.1 - female)

YEAR	Status as per 1 Jan	Arrival	Departure	Born	Died	Status as per 1 Dec
1971	0	4.6		-		10 (4.6)
1972	10 (4.6)		1.1	-		8 (3.5)
1973	8 (3.5)			-		8 (3.5)
1974	8 (3.5)	1.2	1.0	-		10 (3.7)
1975	10 (3.7)			-		10 (3.7)
1976	10 (3.7)		1.1	-		8 (2.8)
1977	8 (2.6)			0.1		9 (2.7)
1978	9 (2.7)	1.0		0.1	1.3	7 (2.5)
1979	7 (2.5)	0.1		1.0	1.0	8 (2.6)
1980	8 (2.6)	1.0		-		9 (3.6)
1981	9 (3.6)			-	0.1	8 (3.5)
1982	8 (3.5)			-		8 (3.5)
1983	8 (3.5)		1.1	-		6 (2.4)
1984	6 (2.4)			1.1		8 (3.5)
1985	8 (3.5)			-		8 (3.5)
1986	8 (3.5)			1.0		9 (4.5)
1987	9 (4.5)			-		9 (4.5)
1988	9 (4.5)			-		9 (4.5)
1989	9 (4.5)		1.0	1.1		10 (4.6)
1990	10 (4.6)		1.0	0.1		10 (3.7)
1991	10 (3.7)		0.1	2.0		11 (5.6)
1992	11 (5.6)	2.0	1.0	0.3		15 (6.9)
1993	15 (6.9)		1.0	-		14 (5.9)
1994	14 (5.9)		1.1	1.2	0.1	14 (5.9)
1995	14 (5.9)		0.1	1.0	1.0	13 (5.8)
1996	13 (5.8)			0.1	1.2	11 (4.7)
1997	11 (4.7)			0.2		13 (4.9)
1998	13 (4.9)			0.1		14 (4.10)
1999	14 (4.10)		0.1	-	1.0	12 (3.9)

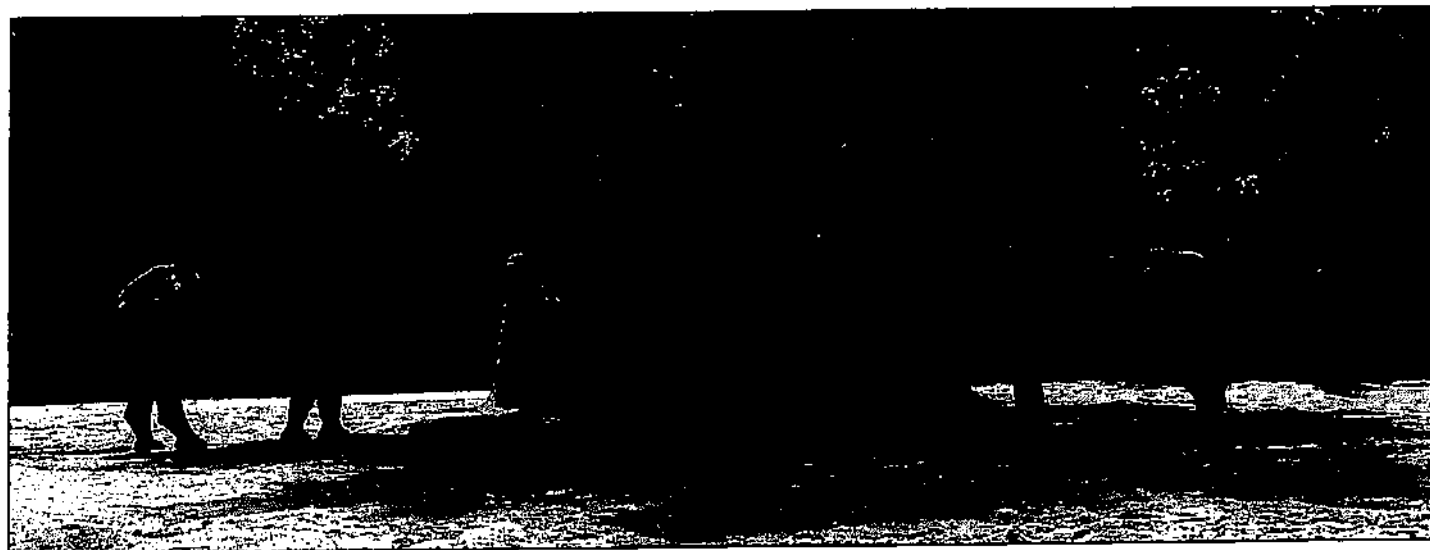
YEAR	Status as per 1 Jan	Arrival	Departure	Born	Died	Status as per 1 Dec
2000	12 (3.9)			1.1		14 (4.10)
2001	14 (4.10)	1.0	0.1	-		14 (5.9)
2002	14 (5.9)	-		0.2	0.1	15 (5.10)
2003	15 (5.10)			-		15 (5.10)
2004	15 (5.10)			0.1	0.1	15 (5.10)
2005	15 (5.10)		1.1	0.1		14 (4.10)
2006	14 (4.10)			1.1	0.1	15 (5.10)
2007	15 (5.10)		1.0	3.0	2.1	14 (5.9)
2008	14 (5.9)	3.0				17 (8.9)
2009	17 (8.9)		2.1	0.2	0.2	14 (6.8)
Total	-	22 (13.9)	23 (13.10)	35 (13.22)	20 (7.13)	-

BASIC GUIDELINES FOR REARING THE BLACK RHINOCEROS

Based on almost 40 years of experience, principles of breeding and management in Dvur Kralove creating optimal conditions for natural reproduction of black rhinos can be generalized as follows:

- Nutrition is critical, so it is desirable to weigh the animals regularly** and respond promptly to the drops in animal weight. In particular, it is necessary to increase timely the ration of nursing females, or cut the nursing period to about 12 months. The diet must be varied and carefully determined to avoid worsening the condition of the mother.
- Another problem is nervousness**, which may be however often very individual. Therefore, it is necessary not to expose animals to unnecessary stress and exploit medicinal sedation. An important factor is the quality of keepers who are working intensively with the animals. Timely getting used to changes in young animals is of great importance.
- Weaning calves at the age of 12 months or earlier does not have an adverse impact on the development and social behaviour in the black rhino, including the subsequent breeding potential.** If calves are weaned earlier, which results in more intense care by the keeper, they seem to be slightly better adapted to the pitfalls of captive breeding than those weaned later. The least stressful weaning procedure is that when the young or the mother is moved away to another house and the calf is immediately associated with another young rhino, including those of other rhino species. At the same time, associating the calf with an individual about a year or more older or grouping with 2-3 other young animals is not a problem.
- The first pairing is an animal-specific process.** It is suitable when an inexperienced female is introduced to an experienced male or sub-adults are left to grow up together, which is again a very individual matter, as sometimes over-aggressiveness of a young male may be an issue. Therefore, introducing inexperienced males to experienced females and grouping males with a pair or trio of friendly females has worked well. Keeper's overseeing to make sure the male aggression does not lead to the "betrayal" of the female is important. Introducing should substantially take place in the enclosure, within a sufficient area and under supervision.
- Monitoring the cycle and pregnancy in females using faeces testing is fundamental, allowing earlier separation of females from males and thus prevent aggressive behaviour, leaving pregnant females at rest.** Males can mostly walk outdoors with females every day, even if the female is pregnant; the female will usually become aggressive to the male after several months of gestation, through which the uniting is cancelled. Occasionally, a male being connected with a female outside her oestrus period may be unpredictably aggressive and therefore requires an individual approach - such males should be associated with females only during oestrus. If animals are tolerant to each other, leaving them together in the enclosure allows extending the length of stay outdoors, which is desirable in the period of the year with a favourable climate.

6. **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 birth using CCTV with a recording feature is ideal**; this will allow evaluating the behaviour of mother and calf, as well as monitoring nursing. For a better stability of the calf when trying to stand up after birth, sprinkling little sand around the box is advisable, which depends on the slipperiness of the wet floor.
7. **Health problems include haemolytic anaemia or black urination; however, the latter may have a different cause.** The treatment should not involve iron-containing preparations, which cause haemosiderosis of organs.
8. **Timely introduction of young females who grow adult around the year 4 to 5 to a male, who is ideally experienced and calm, is important.** It is therefore desirable to have at least 2 males, ideally in each of the houses.
9. **Adult males living in the same house must be located as far from each other as possible and use different enclosures;** nonetheless, the presence of two males may positively influence the regular reproduction.
10. **Rhinos should walk outdoors dally**, in the summer they should ideally have a permanent access out and in, while in winter they can be generally released out even in frosts of -5° to -8°C for a short period, but care should be taken to avoid frostbites of ears. Rhinos like wallowing in the snow; however, staying outdoors may not be too long.
11. **Mud baths should be available to rhinos in summer months;** showering is also useful, but that should not be carried out in the cold months. It is particularly important in winter that humidity inside the house is not high; therefore, neither washing the boxes nor showering the animals is desirable.
12. **In winter, skin problems are manifest, which can be improved through periodic exposure to UV lamps.** Any problem with skin may indicate other health problems, as well as imbalances in the diet.
13. **In hand rearing, the young should be left with the mother and separated only for feeding.** Feeding calves by a horse colostrum after birth and then by maternal horse and rhino milks the first weeks has worked well. In case of hand rearing, making a stock of frozen horse and rhino milk is useful. Leaving the calf grow in the company of the mother even if hand-reared may restore lactation and subsequent nursing.
14. **For some males, especially older and inexperienced or those who have not mated for a long time, a problem with inserting the penis may appear;** if that is the case, the female should be fed near the fencing so that an experienced keeper may assist the male with inserting the penis, which is then normally not needed in future mating attempts.



Jane Lee DK 22 (right) and Mweru, 11 August 2008 (dh)

The overview contains basic historical information about the individual black rhinos that were in possession of or owned by Dvur Kralove Zoo.

History of black rhino keeping at Dvur Kralove Zoo prior to 31 December 2009 (M - male, F - female)

No Name	Sex	ISB/ESB # ARKS #	Born	Arrival In DK Parents	Departure from DK	Died	Comments
1/1/DK/0 Lord	M	169 058001	January 1979 Kenya	22 Aug 1971 Kenya, wild-caught	22 Jun 1972 Jacksonville, USA	22 Apr 1978 San Antonio	
2/2/DK/0 Ken	M	170 058002	January 1979 Kenya	22 Aug 1971 Kenya, wild-caught		8 Nov 1979 Dvur Kralove	1st breeding male
3/3/DK/0 Murray	M	171 058004	February 1970, Kenya	22 Aug 1971 Kenya, wild-caught 2 Oct 1980, Wroclaw, Poland	29 Oct 1974, Wroclaw, Poland 23 Apr 1983, Zurich, Switzerland	2009, Tallinn, Estonia	Loaned from Poland, Lived in Tallinn Zoo since 12 Sep 1988
4/4/DK/0 King	M	172 058003	1970 Kenya	22 Aug 1971 Kenya, wild-caught		22 Apr 1978 Dvur Kralove	2nd breeding male
5/5/DK/0 Zina	F	173 058005	1969 Kenya	22 Aug 1971 Kenya, wild-caught		26 Jun 1978 Dvur Kralove	
6/6/DK/0 Elsa	F	174 058006	1970 Kenya	22 Aug 1971 Kenya, wild-caught		7 Apr 1978 Dvur Kralove	1st breeding female
7/7/DK/0 Jimmi	F	175 058008	February 1970, Kenya	22 Aug 1971 Kenya, wild-caught		21 Aug 2009 Dvur Kralove	3rd breeding female
8/8/DK/0 Lenka (Bonnie)	F	176 058007	1970 Kenya	22 Aug 1971 Kenya, wild-caught	22 Jun 1972 Jacksonville, USA	17 Apr 1982 Columbus, USA	
9/9/DK/0 Tuty	F	177 058010	1970 Kenya	22 Aug 1971 Kenya, wild-caught		24 May 1978 Dvur Kralove	
10/10/DK/0 Jarca	F	178 058009	February 1970, Kenya	22 Aug 1971 Kenya, wild-caught		8 Sep 1996 Dvur Kralove	7th breeding female
11/11/DK/0 Addo	M	216 058013	1971 Kenya	2 Jul 1974 Kenya, wild-caught	20 Apr 1976 Lesna, CR	31 Jan 78 Lesna, CR	
12/12/DK/0 Sabl	F	217 058011	1972 Kenya	26 Jun 1974 Kenya, wild-caught	23 Apr 1983, Zurich, Switzerland	13 Apr 2008 Zurich, Switzerland	2nd breeding female
13/13/DK/0 Satara	F	218 058013	1973 Kenya	2 Jul 1974 Kenya, wild-caught 14 Jul 1979 Lesna	20 Apr 1976 Lesna, CR	24 Apr 1981 Dvur Kralove	Loaned from Lesna in 1979
14/0/DK/1 Elvira DK 1	F	244 058014	2 Oct 1977 Dvur Kralove	Reared In DK Elsa/Ken?King?		25 Feb 1996 Dvur Kralove	4th breeding female

No Name	Sex	ISB/ESB # ARKS #	Born	Arrival in DK Parents	Departure from DK	Died	Comments
15/0/DK/2 Sali DK 2	F	282 058015	5 Jul 1978 Dvur Kralove	Reared in DK Sabi/Ken		25 Feb 2006 Dvur Kralove	
16/14/DK/0 Isis (Bubba)	M	268 058016	3 Nov 1977 Cincinnati	17 Nov 1977 Cincinnati, USA			3rd breeding male
17/0/DK/3 Jimm DK 3	M	283 058017	18 Mar 1979 Dvur Kralove	Reared in DK Jimmi/King 16 May 08, Zu- rich, Switzerland	21 Aug 2007 Zurich, Switzer- land		5th breeding male, Breeding loan, Returned from loan
18/0/DK/4 Eli DK 4	M	386 058018	15 May 1984 Dvur Kralove	Reared in DK Elvira/Isis	1 Oct 1992, Magdeburg, Germany	26 Feb 1995, Magdeburg, Germany	4th breeding male Death - infection
19/0/DK/5 Jessi DK 5	F	378 058019	8 Dec 1984 Dvur Kralove	Reared in DK Jimmi/Isis			6th breeding female
20/0/DK/6 Sado DK 6	M	388 058020	26 Aug 1986 Dvur Kralove	Reared in DK Sali/Isis	18 Oct 1989 Atlanta, USA		Named Boma in Atlanta
21/0/DK/7 Jos DK 7	M	391 058021	21 May 1989 Dvur Kralove	Reared in DK Jimmi/Isis	09 Nov 1990 London, GB		
22/0/DK/8 Sany DK 8	F	417 058022	1 Oct 1989 Dvur Kralove	Reared in DK Sali/Isis	4 Sep 1991 Hannover, Ger.		
23/0/DK/9 Eimi DK 9	F	431 058023	24 Aug 1990 Dvur Kralove	Reared in DK Elvira/Isis		14 May 2004 Dvur Kralove	
24/0/DK/10 Jacob DK 10	M	438 058024	23 Jun 1991 Dvur Kralove	Reared in DK Jessi/Eli	24 May 1994 Krefeld, Ger.		
25/0/DK/11 Jasper DK11	M	450 058025	13 Sep 1991 Dvur Kralove	Reared in DK Jimmi/Isis	6 Oct 1993 Leipzig, Ger.		
26/0/DK/12 Sara DK 12	F	481 058026	24 Feb 1992 Dvur Kralove	Reared in DK Sali/Jimm	14 Jun 1994 Leipzig, Ger.		
27/0/DK/13 Etna DK 13	F	455 058027	8 Dec 1992 Dvur Kralove	Reared in DK Elvira/Jimm	16 Nov 1995 Port Lympne, GB		
28/0/DK/14 Jaga DK 14	F	456 058028	14 Dec 1992 Dvur Kralove	Reared in DK Jarca/Jimm	11 Nov 1999 Port Lympne, UK		
29/15/DK/0 Cody	M	260 058029	20 May 1975 Sydney, Australia	10 Dec 1992 Berlin Zoo, Ger- many	-	19 May 1999 Dvur Kralove	
30/16/DK/0 Mabu	M	277 058030	23 Jan 1979 Magdeburg, Ger- many	1 Oct 1992, Mag- deburg, Germany	-	19 Oct 1996 Dvur Kralove	

No Name	Sex	ISB/ESB # ARKS #	Born	Arrival in DK Parents	Departure from DK	Died	Comments
31/0/DK/15 DK 15	F	539 058031	11 Apr 1994 Dvur Kralove	Reared in DK	-	11 Apr 1994 Dvur Kralove	Stillborn on day 427 of pregnancy
32/0/DK/16 Sauron DK 16	M	541 058032	28 Oct 1994 Dvur Kralove	Reared in DK Sali/Cody	-	24 Sep 2007 Dvur Kralove	
33/0/DK/17 Jiddah DK 17	F	540 058033	15 Nov 1994 Dvur Kralove	Reared in DK Jessi/Mabu		25 Dec 2009 Dvur Kralove	Euthanised - kidney failure
34/0/DK/0 Nana	F	437 058034	4 Apr 1991 Berlin Zoo, Germany	Exchange with Berlin Zoo - loaned to Berlin as of 1 Oct 1993	23 May 1994 Krefeld, Germany		Never arrived in Dvur Kralove; exchanged in 1993 and then sold in 1994
35/0/DK/18 Jonas DK 18	M	562 058035	4 Dec 1995 Dvur Kralove	Reared in DK Jarca/Cody	-	12 Dec 1995 Dvur Kralove	Died during an attempt at hand rearing
36/0/DK/19 Elba DK 19	F	619 058036	5 Sep 1996 Dvur Kralove	Reared in DK Eimi/Cody			
37/0/DK/20 Musso DK 20	F	678 058037	20 Aug 1997 Dvur Kralove	Reared in DK Sali/Jimm		14 Jul 2007 Dvur Kralove	Full name: Ssang Yong Musso
38/0/DK/21 Jola DK 21	F	685 058038	25 Oct 1997 Dvur Kralove	Reared in DK Jessi/Mabu		-	
39/0/DK/22 Jane-Lee DK 22	F	689 058039	24 Jan 1998 Dvur Kralove	Reared in DK Jimmi/Isis		-	
40/0/DK/23 Salome DK 23	F	762 058040	25 Jan 2000 Dvur Kralove	Reared in DK Sali/Jimm	26 Nov 2001 Port Lympne, UK	-	
41/0/DK/24 Jeremy DK 24	M	857 058041	21 Dec 2000 Dvur Kralove	Reared in DK Jessi/Jimm	11 Apr 2005 Chester, UK	-	2009 loaned to Zurich
42/17/DK/0 Mweru	M	659 058042	12 Sep 1996 Port Lympne, UK	29 Nov 2001 Port Lympne, UK		-	
43/0/DK/25 DK 25	F	897 058043	24 Aug 2002 Dvur Kralove	Reared in DK Eimi/Sauron	-	24 Aug 2002 Dvur Kralove	Stillborn
44/0/DK/26 Ema Elsa DK 26	F	898 058044	2 Nov 2002 Dvur Kralove	Reared in DK Elba/Jimm	11 Apr 2005 Chester, GB		Loaned until 2009; to be exchanged for Bashira
45/0/DK/27 Deborah DK 27	F	924 058045	11 Sep 2004 Dvur Kralove	Reared in DK Jiddah/Jimm	27 May 2009 Mkomazi NP, Tanzania		Arrival at Mkomazi NP, Tanzania, on 29 May 2009

No Name	Sex	ISB/ESB # ARKS #	Born	Arrival in DK Parents	Departure from DK	Died	Comments
46/0/DK/28 Malsha DK 28	F	965 058046	21 Dec 2006 Dvur Kralove	Reared in DK Musso/Isis	-		
47/0/DK/29 Jamie DK 29	M	967 058047	2 Jan 2006 Dvur Kralove	Reared in DK Jessi/Sauron	27 May 2009 Mkomazi NP, Tanzania	-	Arrival at Mkomazi NP, Tanzania, on 29 May 2009
48/0/DK/30 Etosha DK 30	F	976 058048	4 Sep 2006 Dvur Kralove	Reared in DK Elba/Jimm	-	-	
49/0/DK/31 Jabu DK 31	M	986 058049	1 Feb 2007 Dvur Kralove	Reared in DK Jola/Isis	27 May 2009 Mkomazi NP, Tanzania	-	Arrival at Mkomazi NP, Tanzania, on 29 May 2009
50/0/DK/32 DK 32	M	987 058050	22 Sep 2007 Dvur Kralove	Reared in DK Jane Lee/Mweru	-	22 sep 2007 Dvur Kralove	Immature birth
51/0/DK/33 Dzanty DK 33	M	988 058051	24 Nov 2007 Dvur Kralove	Reared in DK Jiddah/Jimm	-	-	
52/18/DK/0 Davu	M	970 058052	19 Feb 2006 Krefeld, Germany	3 Apr 2007 Krefeld, Germany	-	-	
53/19/DK/0 Baringo II	M	483 058053	3 Dec 1992 Port Lympne, UK	6.6.2008 Port Lympne, UK	-	-	
54/0/DK/34 Eva DK 34	F	? 058054	8 Dec 2009 Dvur Kralove	Reared in DK Elba/Baringo II			
55/0/DK/35 Jasmina DK 35	F	? 058055	13 Dec 2009 Dvur Kralove	Reared in DK Jessi/Baringo II			
56/0/DK/0 Bashira	F	? -	15 May 2009 Chester, UK	Kept in Chester			To be exchanged for Ema Elsa (on loan) once weaned

Explanation for figures: 25/0/DK/11: 25 - Historical (time) serial number of individual at Dvur Kralove Zoo
0 - Historical serial number of import to Dvur Kralove Zoo
DK - Dvur Kralove Zoo symbol
11 - Historical serial number of birth at Dvur Kralove Zoo



Deborah and Jamie in the enclosure inside the bush, area 1,600 m²; 27 June 2009 (dh)