

CASE REPORTS AND VETERINARY ASPECTS OF BREEDING THE INDIAN RHINO (*RHINOCEROS UNICORNIS*) AT STUTTGART ZOO

W. RIETSCHEL

Address

Zoological and Botanical Garden Wilhelma, P.O.B. 50 12 27, D-70342 Stuttgart, Germany

Summary

Since 1968 Indian rhinos have been kept at Stuttgart zoo. Relevant diseases and veterinary treatments during the last 15 years are reported. One male had to be put asleep aged 30 years after several intensive treatments due to constipation of the large intestine and recurrent oesophageal obstructions. One female died by cardiac shock aged 27. In this animal after the 10th pregnancy an endometritis and an anoestrus had been treated. The current breeding pair of Indian rhinos at Stuttgart zoo showed tapeworm infections and horn fracture in the cow and chronic foot disease and aggressive behaviour in the bull.

Zusammenfassung

Seit 1968 werden in Stuttgart Panzernashörner gehalten. Es wird über relevante Erkrankungen, tierärztliche Behandlungsmassnahmen und Todesfälle der letzten 15 Jahre berichtet. Ein Nashornbulle musste nach mehreren Therapien wegen Obstipation und rezidivierender Schlundverstopfung im Alter von 30 Jahren eingeschläfert werden. Die Nashornkuh verstarb im Alter von 27 Jahren an Herz-Kreislaufversagen. Bei diesem Tier war nach der 10. Trächtigkeit eine Endometritis und Anöstrie behandelt worden. Bei dem gegenwärtig in der Wilhelma gehaltenen Zuchtpaar wird ein Bandwurmbefall und ein Hornverlust bei der Kuh sowie chronische Hufprobleme und aggressives Verhalten bei dem Bullen beschrieben.

Résumé

Depuis 1968, le Jardin zoologique et botanique Wilhelma de Stuttgart détient des rhinocéros de l'Inde. Voici une présentation des maladies importantes constatées dans ce zoo, les traitements vétérinaires administrés et les décès de ces 15 dernières années. Un rhinocéros mâle de 30 ans a dû être euthanasié après plusieurs traitements pour cause de constipation et d'obstruction oesophagienne récidivante. Une femelle de 27 ans est décédée d'une crise cardiaque. Après sa dixième gestation, cette femelle avait subi un traitement en raison d'une métrite post partum et d'absence d'oestrus. Chez ce couple de rhinocéros reproducteurs, on a décelé, chez la femelle, une infestation par des ténias et la perte de la corne, chez le mâle, une pododermatite chronique et un comportement agressif.

Keywords

Indian Rhino, *Rhinoceros unicornis*, pyodermia, constipation, oesophageal obstruction, endoscopy, endometritis, anoestrus, tape worms, *Anoplocephala gigantea*, horn fracture, pododermatitis, aggressive behaviour, perphenazine

Indian Rhinos have been kept at Stuttgart Zoo since more than 30 years. 1.0 Puri, born 1967 and 0.1 Nanda, born 1965 descended from Basel Zoo. The first calf was born in 1971 and killed immediately by the mother. 9 more rhinos were bred at Stuttgart and raised by Nanda without any problem. On July 13 1992 Nanda died by cardiac shock caused by stress. 1.0 Puri being exposed to the same stress survived but showed serious symptoms of various diseases and despite intensive treatments he never recovered completely. Puri had to be put asleep in February 1997. In 1993 Sani, a 6 month old Indian rhino arrived from Chitvan National Park in Nepal. Beside a heavy infestation with tapeworms Sani grew up without any problems and seems to be pregnant since December 1998. Bruno, a son of Nanda and Puri was born January 1985. The animal had been transferred to Cologne Zoo in December 1987 and returned to Stuttgart in April 1997. Compared with other zoo-mammals there have been remarkably few disease problems with Indian rhinos at Stuttgart zoo within the last 15 years. Some of them seem to be interesting enough to be presented in this paper. Treatments of 2.0 rhinos required seven immobilizations. 16 blood samples were taken from 2.0 rhinos and sent to a diagnostic laboratory. The results corresponded with those available in literature (1,2).

Pyodermia, Pneumonia and myocardial disorder, constipation of the large intestine and obstruction of the oesophagus in 1.0 Indian rhino "Puri"(1967-1997)

In September 1987 1.0 rhino "Puri" showed apathy, anorexia and heavy pruritus. There were multiple pisiform seropurulent pustules all over the body. Additional large exudative skin erosions caused by abrasions covered neck, shoulders, lateral abdomen and thighs. The glans penis showed an ulcer of thumbnail size (2,6). Samples from the skin pustules were taken and sent for bacteriology with the following results:

Nonspecific polybacterial microbial flora (coliform germs, *Aeromonas* spp.)

β -haemolytic streptococci and staphylococci without haemolysis.

The animal was treated with injections of penicillin-streptomycin and corticosteroids. The skin alterations were washed with soap, rivanol- and entozon solutions and covered with a sulfonamide-cod liver oil ointment. The animal responded good to the treatment and the pustules were healing with cicatrication.

In 1988 a similar dermatitis was observed in Puri, the female rhino Nanda and a calve (Noel) born in December 1986. The quantity of pustules in all three rhinos was much less than in 1987 and none of the animals showed any other symptoms of disease. Similar skin alterations have been observed in later years in Indian rhinos at Munich zoo, Cologne zoo and Singapore zoo (8), all those zoos had received rhinos from Stuttgart. In 1989 virological examinations revealed the suspicion of a virus caused disease. Pox virus could be excluded but based on electron microscopy there was the presumption of a herpes virus (5). As in similar cases in other rhino species, herpes virus could never be isolated in chicken egg nor in tissue culture. In one biopsy sample histological examination showed a nematode and there was also the suspicion, that the skin vesicles were in coherence with stings of horse flies (*Tabanus sudeticus*) which were observed regularly during summer on the skin of rhinos at Stuttgart and Munich zoo (8).

In Summer 1992 after several hours of extreme stress and over excitement (8) Puri showed putrid nasal discharge, anorexia and coughing. Rectal temperature was 38° C and the breathing rate of 44 per minute. His condition improved slightly after two weeks of intensive antibiotic treatment. The nasal discharge persisted and it seemed that he lost weight. In November 92 his general condition became very poor, there was almost a complete loss of appetite and only sporadic defecation. A rise of temperature over 38° C required an antibiotic treatment. Over several days attempts to stimulate defecation of the animal (bathing in warm water, regular moving, injections of spasmolytic agents and enemas with warm water, paraffin oil and lubricants) were unsuccessful. Finally a subcutaneous injection of a double horse dosage of neostigmin induced a heavy defecation. At that time blood analysis showed a significant leucopenia (1100 leucocytes/ml blood) and an increase of creatine kinase (1185 U/l) indicating a virus caused disease and a myocardial disorder. This was confirmed to some extent by an electrocardiogram on November 28. A rectal examination of the animal revealed an impaction of the large intestine and a complete atony in those parts of the intestine which were palpable.

A haematocrit of 51% indicated a dehydration of the animal and immediate action seemed to be necessary. The animal was immobilized and the following treatment performed:

Enemas with warm 1% saline solution

5 l of paraffin oil and 800g of sodium sulfate (Glaubers salt) solved in warm water via stomach tube.

happened directly after calving. The calf developed satisfactorily but Nanda became increasingly apathetic and anorectic. On February 18 a large quantity of yellow-green evil-smelling vaginal discharge appeared. The vestibulum seemed to be slightly hyperaemic and was treated with Entozon® ointment. The bacteriological examination showed a mixed flora of β -haemolytic streptococci, *E. coli* and aerobic spore-forming bacteria. After two antibiotic treatments with a long acting penicillin/ streptomycin on February 19 and 21 the amount of discharge was reduced, but there seemed to be no improvement of the general health and the animal lost weight. A swab taken on February 22 showed a pure culture of *Corynebacterium pyogenes*, sensitive to penicillin, amoxycillin and chloramphenicol. On February 27 the antibiotic treatment was repeated. Samples taken on February 25 and March 1 did not show any bacteriological growth but a slight growth of fungi. Analogous to the treatment of pyometra in cattle, a treatment with prostaglandins (20 ml of Iliren® = 3 mg Tiaprost) was performed on March 4. After March 6 no more vaginal discharge was visible and the animal started to eat normal and recovered slowly. No heat could be observed during four months after partition. On July 10, an analogical gonadotropin releasing hormone (10 ml Receptal®= 0.04 mg Buserelin) was injected. On August 28, a double horse dose of a roborant, Selen, Vitamin A and Vitamin E were injected. Beside the usual minerals 1 g of iron was added to the food ration. In addition, the clitoris and labiae of the animal were stimulated by the keepers by manual massage with a humid, warm sponge.

In the morning of September 9, 214 days p.p. Nanda showed significant heat symptoms and was mated by Puri the evening of the same day.

Nanda died on July 13, 1992 due to some unhappy circumstances in coherence with a behavioral enrichment activity(7). The final diagnosis of the post mortem was death by acute central circulatory shock. Other findings were an overloaded stomach and a 52 cm long female fetus. The histological examination of the internal organs did not show any pathological alterations.

Tape worm infestation, suspected urinary tract infection and fracture of the horn in 0.1 Indian rhino "Sani"(*1992)

0.1 Rhino Sani arrived from Nepal in July 1993. There had been some minor problems with diarrhoea and constipation, possibly caused by the diet. In February 94 lots of proglottides of *Anoplocephala gigantea* were found in the faeces. The animal was treated with fenbendazol (7,5 mg/kg bodyweight). In August 94 another excretion of proglottides was observed and the treatment was repeated three times within a four week interval. The next tape worm proglottides were detected in February 95. This time the animal was treated with Droncit® (1 mg praziquantel/kg body weight p.o.) three times in monthly intervals. After the first two treatments masses of *Anoplocephala* proglottides were excreted but there have been no further findings of this parasite from the third treatment up to now.

In April 1998 and July a change of behaviour indicated a possible infection of the urinary tract. The rhino was anorectic, aggressive and seemed to have pains when trying to lie down. The animal was moving all day and night and did not even rest in the bath. Faeces were dropped in small portions all over the inside and outside area and not at the usual defecation place. It was not possible to collect any samples and due to the fact that the animal was 5 months pregnant an immobilization was out of question. Finally the animal seemed to respond to a treatment with enrofloxacin (Baytril®) and perphenazine (Decentan®) a long acting tranquillizer.

On October 9, 99 the horn of Sani was found on the outside enclosure. The animal did not show any excitement or distress and tolerated a local treatment with antibiotic powder and tar (Pix liquidum). As described by Fowler (1) regrowth began immediately and after two months the complete surface of the wound was covered with epithelium and a new horn measuring almost one centimetre was visible.

Pododermatitis profunda, aggressive behaviour and a mysterious mating technique in 1.0 Indian rhino "Bruno"(* 1985)

When "Bruno " arrived at Stuttgart in April 97, the animal showed extreme aggression against staff and equipment such as pushcarts and water containers. One keeper had to be hospitalized due to a perforating horn butt in the chest. At the soles of both hind legs there were deep fissures located caudal of the medial nail. Prevalence and possible pathogenesis of this common chronic foot disease were presented and discussed at the EAZW meeting in Chester (3) and the meeting of the German zoo veterinarians at Berlin (9) . Up to now the treatment and nail trimming of Bruno required 4 immobilizations. 1.0 rhino Puri had been immobilized three times without any side effects with 20 mg xylazin and 0.8 ml Immobilon®, injected by hand (8). It has to be considered that Puri was at that time in a very poor health condition and had much less weight than Bruno. 1.0 rhino Bruno needed 1.2 ml

40 l of Ringer solution, 3 l of electrolyte solution and 30 ml of Novalgin® applied via ear vein. By using a 6m tube the infusion could be continued for more than 6 hours, even after injection of the antidote when the animal was up and walking in circles in the box.

After the infusion haematocrit had decreased from 51% to 34%.

It took about one month for Puri to recover. For two weeks neostigmin injections were necessary to induce defecation. On Dec. 11 there was the first spontaneous defecation, the appetite increased, and the number of white blood cells raised from 1350 (Dec. 3) to 6900 (Dec. 15). There was an impressive preputial edema which disappeared after two weeks. At the end of Dec. 92 the animal consumed normal quantities of food and seemed to gain weight. Over the following years Puri showed recurrent skin pustules and permanent nasal discharge. In August 96 a seropurulent nasal discharge, coughing and lack of appetite, specially after eating hay and pellets, was observed. The condition improved after the ration of green forage, vegetables and fruits was increased and hay was moistened. Due to an increase of body temperature and heavy coughing an antibiotic treatment was performed. A blood check on September 12 showed 8200 leucocytes. Retching was observed and parts of food were found in the nasal discharge. The animal refused apples but preferred to eat bananas, leaves and branches and nibbled regularly at a door-beam and other constructions made of pine wood. On Sept. 19 Puri was very nervous, saliva was dripping out of the mouth, the animal had obvious difficulties in swallowing. There were symptoms of respiratory distress when trying to swallow. The animal was hungry for small quantities of fruits which were chewed and vomited after some minutes through mouth and nose. No intake of water was observed, the behaviour seemed to be abnormal, the animal even refused to take the daily bath. According to the clinical picture there was the suspicion of an obstruction of the oesophagus.

On Sept 22 the rhino was immobilized for endoscopy. A 1.8 m, 18 mm flexible bronchoscope (Wolff) was introduced through the ventral nasal meatus without any problems. Multiple ulcers were found in the pharynx and larynx. The trachea was visible up to the bifurcation and looked normal. Even with the aid of a second endoscope it was not possible to enter the oesophagus. The mouth was opened by force and secured with a wooden beam. Fortunately a veterinarian with extreme long arms was present who could palpate the cranial part of the oesophagus. The finding was an obstruction by 600 g of impact wooden chips (pine wood). After the removal of the obstructing material it was possible to introduce the endoscope into the oesophagus. Multiple ulcers of different size were visible in the cranial part (30 cm) of the oesophagus. The next 90 cm seemed to be normal. The teeth showed typical alterations due to old age. The surface of the teeth could be smoothed by use of a tooth rasp and a dental forceps.

After an antibiotic treatment Puri seemed to recover slowly but there were regular problems with swallowing food, which could be solved by offering gruel with vegetable oil and a special diet with low fibre content, fruits and concentrates and hay-pellets mixed with water. The appetite could be stimulated with fresh corn plants which were delivered daily by a farmer.

In November several recurrences of oesophageal obstruction were observed, all but one disappeared spontaneous. On Nov 18 another immobilization was necessary. The endoscopy of larynx and pharynx showed no ulcers but a diverticulum was found in the cranial part of the oesophagus. The obstruction was caused by 480 g of corn fibre which could be removed.

On February 20 the general poor condition of Puri required euthanasia. Unfortunately due to a suspected outbreak of mad cow disease up country no pathologist was available for necropsy. Organs were collected by zoo staff and sent for pathology. Results of the pathological examination were rather disappointing. Almost nothing was found beside an atrophy of the coronary groove, defects in the mucous membranes of the intestine, enteritis and a chronic putrid inflammation of the tissue around the oesophagus.

Endometritis, anoestrus and cardiac shock in 0.1 Indian rhino "Nanda"(1965-1992)

The duration of 10 pregnancies in Nanda was between 459 and 481 days. The first heat could be observed 97 to 119 days after calving. If mating was not successful the next heat could be observed about 43 days later. The last three calves were caused by mating during the third heat after parturition. Her tenth pregnancy (mating August 27, 1989) seemed to be normal. On January 29, 1991 the mammary gland was well filled, the labiae showed an edematous swelling and the pelvic ligaments seemed to be soft. On January 30 a white vaginal discharge was observed and samples were sent for bacteriological analysis. The results showed beside a growth of β -haemolytic streptococci non-specific germs, the sample was not collected under sterile conditions and there was no symptom of any disease. Considering the approaching birth a treatment seemed not to be indicated. On February 11 a healthy female calf was born. The placenta was expelled on the next day, normally that should have

... directly after caiving. The caive became increasingly apathetic and anorectic. On February 18 a large quantity of yellow-green evil-smelling vaginal discharge appeared. The vestibulum seemed to be slightly hyperaemic and was treated with Entozon® ointment. The bacteriological examination showed a mixed flora of β -haemolytic streptococci, *E. coli* and aerobic spore-forming bacteria. After two antibiotic treatments with a long acting penicillin/ streptomycin on February 19 and 21 the amount of discharge was reduced, but there seemed to be no improvement of the general health and the animal lost weight. A swab taken on February 22 showed a pure culture of *Corynebacterium pyogenes*, sensitive to penicillin, amoxycillin and chloramphenicol. On February 27 the antibiotic treatment was repeated. Samples taken on February 25 and March 1 did not show any bacteriological growth but a slight growth of fungi. Analogous to the treatment of pyometra in cattle, a treatment with prostaglandins (20 ml of Iliren® = 3 mg Tiaprost) was performed on March 4. After March 6 no more vaginal discharge was visible and the animal started to eat normal and recovered slowly. No heat could be observed during four months after partition. On July 10, an analogical gonadotropin releasing hormone (10 ml Receptal®= 0.04 mg Buserelin) was injected. On August 28, a double horse dose of a roborant, Selen, Vitamin A and Vitamin E were injected. Beside the usual minerals 1 g of iron was added to the food ration. In addition, the clitoris and labiae of the animal were stimulated by the keepers by manual massage with a humid, warm sponge.

In the morning of September 9, 214 days p.p. Nanda showed significant heat symptoms and was mated by Puri the evening of the same day.

Nanda died on July 13, 1992 due to some unhappy circumstances in coherence with a behavioral enrichment activity(7). The final diagnosis of the post mortem was death by acute central circulatory shock. Other findings were an overloaded stomach and a 52 cm long female fetus. The histological examination of the internal organs did not show any pathological alterations.

Tape worm infestation, suspected urinary tract infection and fracture of the horn in 0.1 Indian rhino "Sani"(*1992)

0.1 Rhino Sani arrived from Nepal in July 1993. There had been some minor problems with diarrhoea and constipation, possibly caused by the diet. In February 94 lots of proglottides of *Anoplocephala gigantea* were found in the faeces. The animal was treated with fenbendazol (7,5 mg/kg bodyweight). In August 94 another excretion of proglottides was observed and the treatment was repeated three times within a four week interval. The next tape worm proglottides were detected in February 95. This time the animal was treated with Droncit® (1 mg praziquantel/kg body weight p.o.) three times in monthly intervals. After the first two treatments masses of *Anoplocephala* proglottides were excreted but there have been no further findings of this parasite from the third treatment up to now.

In April 1998 and July a change of behaviour indicated a possible infection of the urinary tract. The rhino was anorectic, aggressive and seemed to have pains when trying to lie down. The animal was moving all day and night and did not even rest in the bath. Faeces were dropped in small portions all over the inside and outside area and not at the usual defecation place. It was not possible to collect any samples and due to the fact that the animal was 5 months pregnant an immobilization was out of question. Finally the animal seemed to respond to a treatment with enrofloxacin (Baytril®) and perphenazine (Decentan®) a long acting tranquillizer.

On October 9, 99 the horn of Sani was found on the outside enclosure. The animal did not show any excitement or distress and tolerated a local treatment with antibiotic powder and tar (Pix liquidum). As described by Fowler (1) regrowth began immediately and after two months the complete surface of the wound was covered with epithelium and a new horn measuring almost one centimetre was visible.

Pododermatitis profunda, aggressive behaviour and a mysterious mating technique in 1.0 Indian rhino "Bruno"(* 1985)

When "Bruno " arrived at Stuttgart in April 97, the animal showed extreme aggression against staff and equipment such as pushcarts and water containers. One keeper had to be hospitalized due to a perforating horn butt in the chest. At the soles of both hind legs there were deep fissures located caudal of the medial nail. Prevalence and possible pathogenesis of this common chronic foot disease were presented and discussed at the EAZW meeting in Chester (3) and the meeting of the German zoo veterinarians at Berlin (9) . Up to now the treatment and nail trimming of Bruno required 4 immobilizations. 1.0 rhino Puri had been immobilized three times without any side effects with 20 mg xylazin and 0.8 ml Immobilon®, injected by hand (8). It has to be considered that Puri was at that time in a very poor health condition and had much less weight than Bruno. 1.0 rhino Bruno needed 1.2 ml

Immobilon® and 30mg xylazine to go down and showed extreme convulsions and even managed to stand on both front legs when going down. These side effects could be avoided with a premedication of 500 mg of perphenazine injected about three to five days before the immobilization. Additionally an increased dose of xylazine (50 mg) was injected about 20 min prior to the Immobilon® (9). First matings of Bruno and Sani were not effective. It cannot be excluded that one of the reasons was pain caused by the condition of Brunos hind legs. After several treatments and some reforms in the inside and outside enclosure the condition of Brunos feet improved (9). In the morning of December 14, 1998 Sani was in heat and both animals were let together for several hours. No mating could be observed by the keepers. According to faecal progesterone levels investigated by Schwarzenberger et al. (10) Sani is pregnant since December 1998. Supposing that the observations of the keepers are reliable, a young Indian rhino born in April 2000 might be the first documented case of an immaculate conception after two millenniums (4).

Discussion

As mentioned already in the introduction there have been remarkable few disease problems with Indian rhinos at Stuttgart zoo. One of the main reasons for the good health condition and the impressive productivity might be the holding conditions with a heated inside and outside pool and the quality of the staff. It cannot be excluded, that there is a coherence between the recurrent dermatitis, observed first in the bull Puri in 1987 and the respiratory infections, the constipation and circulatory problems in 1992 and the ulcers in the oesophagus causing obstructions in 1996 and finally the death of the animal in 1997. The leucopenia in 1992 and investigations by electron microscopy indicate a viral disease. The fact that there have been seropurulent skin alterations and ulcers at the oesophagus, pharynx and glans penis is suspicious for the group of herpes viruses. Similar cases have been observed in various rhino collections in European and American zoos (2) and it might be just a matter of time and new laboratory technologies that the infectious agent is identified. Rhinos seem to be extremely sensitive to stress. With some training, in most of the cases injections could be given by hand and minor treatments could be performed by the staff without sedation. With the help of the keepers it was even possible to collect blood samples from one of the ear veins by use of a butterfly-needle. In excited or aggressive animals, prior to transports, after transfers or for veterinary manipulations long acting tranquilizers like perphenazine seem to be a helpful tool to avoid accidents. According to our experience in rhino-immobilizations by use of etorphin, convulsions and other side effects can be avoided with a premedication of perphenazine given three days in advance. Finally it should be mentioned that in rhinos behavioral enrichment programs should be implemented with extreme care; eventually under sedation with long acting tranquilizers.

Post script:

Wonders do happen

On February 12th, 2000, Sani gave birth to a female calf. The estimated length of pregnancy was only 424 days; 40-50 days less than average. Despite a birthweight of about 42 kg "Sarasvati" is developing well and shows a satisfactory weight gain (February 21th: 52,7 kg!)

Acknowledgements

I would like to thank the staff of the Wilhelma pachyderm house for the good cooperation. Most of the diagnostic procedures and treatments would not have been possible without the help of Mr. Volker Scholl, Mr. Oliver Pürkel and Mr. Ralph Dillmann. I thank also Dr. Peter Witzmann and Dr. Ulrich Walliser of the Horse Clinic Kirchheim/Teck for support in intensive treatments, endoscopy and ECG.

References

1. Fowler M.E. Zoo and wild animal medicine. W.B. Saunders Company, Philadelphia London Toronto. 1978
2. Göltenboth R. Nashörner. In: Göltenboth R und Klös HG (Eds) Krankheiten der Zoo- und Wildtiere. Blackwell Wissenschafts Verlag Berlin. 1995; 209-33.

3. Houwald F v and Flach E J. Prevalence of chronic foot disease in captive greater one-horned rhinoceros. EAZWV, 1998; 323-7.
4. Lukas. Das Evangelium des Lukas. Das Neue Testament. Reprint of the translation by Luther, M. 1522; 1.31
5. Pilaski J and Rietschel W. Eine virusbedingte Hauterkrankung beim Panzernashorn (*Rhinoceros unicornis*). Unpubl manuscript. 1989
6. Rietschel W. Dermatitis beim Panzernashorn. VAZ 8, 1988;121-2.
7. Rietschel W. Pyometra beim Panzernashorn. VAZ 12, 1992; 40-1.
8. Rietschel W. Obstipation und Schlundverstopfung beim Panzernashorn, VAZ 16,1996;103-9.
9. Rietschel W. Erfahrungen bei der Fußpflege von Elefanten und Panzernashörnern. Anwendung von Perphenazin beim Panzernashorn. VAZ 18, 1998; 28-30.
10. Schwarzenberger F, Rietschel W, Vahala JW, Holeckova D, Thomas P, Malzahn J, Baumgartner K and Schaftenaar W. Faecal progesterone, estrogen and androgen metabolites for non-invasive monitoring of reproductive function in the female Indian rhinoceros, *Rhinoceros unicornis*. Gen Comp Endocrinol. In Print. 1999.

