

## **3. BEHAVIOR & MANAGEMENT**

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(G. Guldenschuh)

Indian rhinos are basically solitary animals, seldom grouping except for cow-calf pairs. If there are groupings, they are in general either all female or all male at wallows or grazing areas.

### **3.1. GROUP SIZE**

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It is recommended that average sized zoos keep one to three females and one breeding male. Extremely large facilities like ranches, safari parks and the like may maintain an even higher number of females, or, from a genetic point of view, may want to keep several, separated pairs allowing more males into the reproductive process. Only under urgent circumstances and for as short a time as possible should single individuals be kept since they are most likely to develop stereotypical behavior.

### **3.2. GROUP COMPOSITION**

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In average sized zoos the females may be kept on the same outdoor enclosure, usually separated from the breeding male except for mating (see 3.3.3. Introductions of a Female to a Male for Breeding Purposes). Extremely large facilities may keep numerous females along with the breeding male on an ongoing basis.

Considering the endangered status of the Indian rhino and the small number held in captivity, it is strongly recommended that all animals be held with the intent of breeding. Exhibit-only animals should be limited to those males over represented in the gene pool and pre- or post-reproductive males or females.

The keeping of bachelor groups may be possible, and in the future even necessary, although it has not been attempted to date. A potential advantage would be bulls reaching full maturity in the absence of females and corresponding pheromones (see also 3.5.4. Offspring Management).

### **3.3. INTRODUCTIONS**

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Because Indian rhinos are primarily solitary and territorial, great care must be given when introducing animals to one another. Proper introduction procedures can minimize injury from aggression. Animal disposition, enclosure size and design (see 4.1. Outdoor Enclosures), personnel experience and competence, and general environmental conditions (such as high temperatures, slippery ground, construction site noises, and so forth) must be taken into consideration. These factors will influence the time requirements for introductions. Aggression should be expected in all introductions, regardless of the sex, age or disposition of the animals involved.

It is strongly recommended, physical introductions take place on the largest available enclosure, preferably outdoor. Before animals are introduced they should have the opportunity of getting familiar with the enclosure to be used.

Besides the curator and the head keeper a veterinarian with immobilization equipment should be present for first-time introductions, with a possible need for additional keepers for observation and animal safety purposes. Experienced rhino keepers armed with whips or other noise producing instruments might be positioned at trouble spots (such as a dry moat). More serious interventions may require high-pressure fire hoses, electroshock devices, CO<sub>2</sub> fire extinguishers and / or, on larger facilities, vehicles for separation of the animals. Never try to intervene by stepping in physically. An aroused bull in a mating frenzy would not give in to any attempt to stop him and he might even attack. Although they may not look like it, they are very, very fast! If a barn is opened and used to separate individuals, only one animal should be allowed to enter a stall and must not be allowed to become trapped by an aggressor. Even when fighting escalates, aggression may quite effectively be mollified by widely distributing preferred food (browse, apples, bread, carrots, etc.) throughout the enclosure.

It is necessary for the enclosure to provide ample space, visual barriers and hideout, ensuring escape with no opportunity for an animal to be cornered or trapped. Smaller enclosures should be designed with central structures (rubbing rocks, pools, etc.) as run-arounds (see 4.1. Outdoor Enclosures). It is recommended to drain deep-water pools and fill them with substrate to prevent injury. On the other hand, shallow pools filled with water are ideal 'buffer zones' to slow down pursuits and to cool down the 'opponents'. To avoid dry moat accidents, visual barriers or electric wires (if the animals are familiar with them) should be positioned at the moat edges. These should already be in place, as a newcomer gets familiar with an enclosure prior to introduction.

### **3.3.1. Introduction of a New Female - or Subadult Male - to Female(s)**

In preparation for physical introduction provide first auditory and olfactory, followed by visual contact between the newcomer and the established female(s). Next, allow tactile contact through bars. If an animal displays prolonged stress-related behavior including but not limited to excessive pacing, running, vocalization, and / or escape attempts from its stall, introduction should revert to the just previous level. Before actually being physically introduced the animals should no longer show aggression toward each other. In average sized zoos it is recommended introductions begin with the most 'sociable' and 'obliging' individual of the group. On larger enclosures a newcomer may be introduced to an entire group directly.

However, it should be noted that successful introduction of individuals is largely dependent on the introduced animal's personality. Introductions should be avoided if any involved female is in estrus.

At facilities where animals usually stay together 24 hours a day, newly introduced animals should be left together as long as supervision is available. If it is necessary to separate them at night for either supervisory reasons or climatic conditions, it should be for the shortest period of time possible. This will help to settle the newly established hierarchy quicker given it will not have to be re-established anew every morning. Maintain a high level of monitoring until aggressive behavior subsides.

### **3.3.2. Reintroduction of a Female with a New Calf to Female(s)**

Cows with newly born calves are reintroduced to the other female(s) between 3 weeks and 3 months (with an average of 6 weeks), depending on the mother's group rank and her maternal experience. A cow-calf reintroduction follows the same procedures as a new female introduction (see 3.3.1. Introduction of a New Female). It is preferable for safety reasons for the cow-calf pair to acclimate to only one individual female at a time. For these physical introductions the pair should be first on the enclosure with the other female allowed access only after the cow-calf pair has relaxed.

Special precautions must be taken regarding pools and / or water moats to eliminate the risk of a calf drowning.

If two or more mothers with calves are on the same enclosure, some calves might try to feed on several females. Close observation is needed because some cows react pretty aggressively toward such attempts.

### **3.3.3. Introduction of a Female to a Male for Breeding Purposes**

Whenever possible connect the female's enclosure with the male's, but only if two large gates create a 'run-around' situation. If this is not possible, use the largest enclosure available. In preparation of the physical introduction, both animals should be allowed to get familiar with the enclosure(s) to be used. If the enclosure is not his own, the male should be given the time to mark it. Dung heaps should not be removed. In preparation for physical breeding, the female should be first onto the joint enclosure, eliminating the possibility of an overly enthusiastic male from pushing the cow back into her stall and cornering her.

Successful breeding is a timing issue. The duration of estrus is only 24 hours. When (often in the early morning) a female is observed displaying suspected estrus behavior (raspy 'whistling' breathing, frequent urination and nervous pacing), the potential breeding pair should be allowed visual and tactile contact. If the female's breathing becomes more labored with urination increasing to frequent squirts (every 15 to 20 seconds) and the male shows interest, the physical introduction should be immediately pursued (see 3.4.2. Estrus and Courtship). If your bull is known to be aggressive and rambunctious, delaying visual and tactile contact a few hours is recommended. This has proven effective in calming down the bull during the courtship process. It is common to observe a bull responding more strongly to a female during the two days prior to peak estrus. A possible explanation might be that in the wild a solitary female would need to attract males to her in time for mating at peak estrus.

It must be stressed that, particularly in Indian rhinos, successful mating is often preceded by several hours of aggressive behavior that sometimes escalates into serious wound inflicting fighting that may get out of control at any stage. It is a cyclical process of aggression (with the male charging, chasing and / or sparring with the female, and vice versa) and recovery (one or both lying down, often with the still standing animal prodding the other to rise). Preparations should be made for any necessary intervention given the aggressive nature of the courtship. However, do not intervene too quickly; profusely bleeding superficial wounds should be expected and are a natural part of the Indian rhino courtship. In general, young and / or inexperienced males tend to be pushier and more aggressive than older more experienced bulls.

Patience is essential given courtship is a long process that may take many hours, with actual mounting and copulation often occurring late at night. Install in advance a powerful source of illumination so you can continue to monitor the activities in the enclosure after dark. At the conclusion of a successful copulation (which usually lasts for about an hour (see 3.4.3. Copulation) the animals are so exhausted they usually separate willingly and are easily led to their stalls.

### **3.3.4. Reintroduction of a Post Partum Female to a Male for Breeding Purposes**

Allow the cow a one-year break after delivery before rebreeding her. If the management of your bull requires an earlier breeding (see 3.5.6. Specific Breeding Recommendations), wait at least one estrus cycle (two or three cycles are better) before the re-breeding. The calf should be separated from its mother before the bull has access to the cow. This separation has to be trained beforehand to keep the calf from constantly calling its mother (see 3.4.5. Calf Development).

After a stillbirth or a calf's death shortly after birth, 3-4 estrus cycles should pass before reintroducing the female to the male, especially if the cause of death is not clear. This allows to diagnose and treat any hidden infections prior to the cow's next pregnancy. Furthermore, the success rates of matings are lower shortly after births and stillbirths. Considering the relatively high level of aggression during courtship and mating, it seems reasonable to limit attempts to periods of high potential for conception.

## **3.4. BEHAVIORAL ASPECTS OF REPRODUCTION**

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Indian rhinos in captivity have a possible 40-year life expectancy; in the wild it is in the range of 30 years. In captivity, bulls show no drop in fertility throughout their lives. Females in captivity reproduce between the ages of 4 and 32 years, with a declining reproduction rate starting in their mid-twenties. The average generation time is 15 years (Wirz-Hlavacek, 1998).

In the wild, birth intervals are about 3 years. The mother and her calf stay together until the cow's following birth; when she will, for at least a few months, not allow her now grown-up offspring to get close to her and the new calf. Following this period, the cow, recognizing her offspring lifelong, will tolerate them in her vicinity when she would normally chase another rhino away. Her tolerance will be greater for her daughters than her sons.

### **3.4.1. Sexual Maturity**

In the wild, the Indian rhino will reach sexual maturity at approximately nine years for males and five for females. As recorded in captivity to date, with ages approximate, males have successfully fertilized at six years and three months and a female has become pregnant at two years and eleven months, giving birth at the age of four years and 77 days. However, a three-year old female is not yet full-grown and a big bull may be too heavy for her.

Seemingly, rhinos' sexual maturity is trending to be earlier the longer the species is kept in captivity. For males, a contributing factor may be the unnatural absence of dominant older bulls.

### **3.4.2. Estrus and Courtship**

Based on data currently available, estrus cycle lengths have been recorded from 34 to 48 (58) days, differing from individual to individual. This broad time frame needs to be looked at cautiously since estrus is not always easily recognized or readily noticed. However, for a breeding female the recurrence of her cycle in regular intervals is more important than the length of her cycle in days. Peak estrus lasts only 24 hours; experienced personnel familiar with the animals can be helpful in managing breeding preparations by recognizing the early, subtler indicators of its imminence.

Over many years at least two females at Basel Zoo have shown a 'double estrus' in the sense that they display signs of estrus for one day, have a break of one to three days, and then go into full estrus for 24 hours. Some bulls show more interest during this 'pre-estrus' than during the real heat. This 'pre-estrus' might serve to attract bulls over a great distance, to draw them into close proximity ensuring availability during the short real estrus.

The first symptoms of estrus include 'whistling', more frequent urination, indifference to food, and restlessness (such as an animal lying down but almost immediately getting back up). It should be noted that some females have gone directly into peak estrus within 30 minutes, displaying none of these early indicators. If animals are kept separately at night, an imminent peak estrus is easily recognizable from the state of the stall in the morning: the walls will be marked with urine; the food trampled and not eaten; and bedding material will be wet and in a state of disarray. Peak estrus signs are labored, raspy 'whistling' breathing, frequent (every 15 to 20 seconds) spraying and squirting of urine, nervous pacing, and vulva swelling with winking and occasional mucous discharge. Intensity of these signs will most likely differ from animal to animal and should not be viewed as an indication of breeding readiness or fertility: It does, however, make it more difficult to recognize an individual animal's onset of peak estrus.

Bulls usually only show signs of interest in females at estrus. During visual and tactile contact (see 3.3.3. Introduction of a Female to a Male for breeding purposes), they will, in no particular order, start the same 'whistling' breathing, to spray urine frequently, to display a 'flehmen' response (a grimace like uplift of the upper lip) and to show a partial erection. Upon physical introduction, bulls usually start chasing the female with short interruptions for genital inspections and licking, nudging her with

their horn, and trying to rest their chin on her rump. During courtship, the role of aggressor will change between the male and female numerous times. Coincidental with genital inspections it is common for both sexes to attempt to lift their partner from behind by lifting their head between the hind legs or from the side by hooking their horn in the hind leg skin fold. Lift attempts are also made from the front in similar fashions. Horn use by Indian rhinos in aggression during breeding is not as dangerous as for African species since their horns are shorter and, at least in captivity, blunter. Instead, their protruding pair of very sharp, lower incisors more frequently inflicts deep wounds. While chasing and pushing their partner, animals often chafe against enclosure structures causing minor bleeding from superficial abrasions, with common injuries ranging from scraped skin knobs to the loss of large epidermal patches. These wounds usually look much worse than they are. Of greater concern is the possibility of the bull flipping the female over (risk of breaking vertebra) or pushing her into the dry moat. Depending on the depth and width of the dry moat, it might be advisable to cover the bottom with straw bales.

However, courtship does not have to be aggressive at all. Occasionally, bulls, especially older ones, may quickly lose interest. After an initial charge and a few circlings, they prefer lying in the shade or standing in the pool, leaving the female to take the active role. It may take hours of prodding and encouragement to 'persuade' the bull to actively continue the courtship.

### **3.4.3. Copulation**

The bull will only develop a full erection when mounting the female. The penis is long and slender, capable of probing for the female's vulva. Nonetheless, it may take him some time to enter her. It is not uncommon for failed attempts to lead to repeated mounts. Full copulations average about an hour (ranging from 30 to 80 minutes, usually late at night), with ejaculations every few minutes. At conclusion, the animals show signs of fatigue and, usually, are easily separated and lead to their stalls.

### **3.4.4. Pregnancy and Parturition**

Indian rhino gestation lasts an average of 479 days, with records indicating a range of between 459 and 496 days (Samuel Zschokke, in Wirz-Hlavacek, 2001). The *AZA Rhinoceros Husbandry Resource Manual* (Fouraker & Wagener, 1996) mentions 516 days as the longest known gestation period.

Pregnancy in Indian Rhinos can be monitored using fecal steroid analyses (Schwarzenberger et al., 2000). Two fecal samples per week should be collected over a period of 8 weeks (frozen) and then be sent to Franz Schwarzenberger (see 10. 3. Addresses for Further Requests).

One month before parturition teat size increases, which is more visible in previously suckled mothers. Also in this time frame, the first movements of the fetus may be visible. Two weeks prior to birth there is further enlargement of the teats with a development of wax plugs. Sometimes, an early swelling and dilation of the vulva may be observed. 48 to 24 hours before birth, the udder grows rapidly; the female becomes increasingly more irritable and restless (frequently laying down and standing up), and loses interest in food.

Indicators of early labor, which may last for hours, include the rhino behaving as if very uncomfortable; pacing; laying down first on one side, then the other, and rising up again almost immediately; pushing her rump against walls or bars and then inspecting the area with her nose and lips; vocalizing; frequently urinating and performing a flehmen response; and, in some instances, beginning to drip milk.

Hard labor is marked by more and more intensive contractions during which the cow often lies on her side; lifting her upper hind leg, and bearing down, coincidental with the contractions. At this time, her vulva becomes fully dilated and will often have a mucous discharge. At some point during hard labor, water break will occur. It then usually takes 1-2 hours, sometimes as little as 15 to 30 minutes, until birth. Deliveries very often occur at night, frequently in early morning hours.

Although births are usually headfirst, breech births are not uncommon. The actual delivery of the calf happens very quickly once the fetal envelope shows. The mother is usually lying during birth, seldom standing. Upon delivery, she immediately stands up, turns (tearing the fetal envelope away) and nuzzles her baby. The fetal envelope may dangle from her vulva until the placenta is discharged, usually right after the birth. In many cases the mother ingests both.

For the infant to be able to stand up, it is necessary to prepare a non-slippery floor surface, especially, if the birth happens on smooth stable tiles. Since hay and straw are often pushed aside during a birth, the use of sand is recommended. It is more effective and can easily be applied locally around the infant while it is trying to get up; but spread only by a staff member the mother is comfortable with given the sensitivity of the moment.

Mothers should be given as much peace and quiet as possible. Only persons the animal is familiar with should be present; and even they should stay away from her unless urgent medical or technical problems arise. The house should be closed to the public. Background disturbances as well as foreigners may cause the female to hold back. Avoid all changes in surroundings that are familiar.

Video cameras are very useful for observing the mother without disturbing her. Use equipment with high light sensitivity so you can work without additional illumination. To allow the mother to get familiar with it, install the camera a few weeks before the expected birth date.

### **3.4.5. Calf Development**

Average birth weight is 64.3 kg (44 to 90.6 kg, n = 36) (Samuel Zschokke, in Wirz-Hlavacek, 2001). And, to date only single calf births have been observed.

Calves commonly get on their feet within 15 minutes, but may take 1 to 2 hours before being coordinated and balanced enough to walk.

First nursing normally begins within 2 hours of birth but can take up to 24. Sometimes a calf tries to suckle at walls, bars and so forth before discovering its mother's teats. Suckling usually begins with the mother upright and the calf standing under her belly. Later the mother may lie on her side with the calf suckling from an upright lying position, in which the infant may fall asleep. During the first few days a calf drinks about every hour for 3-5 minutes, later every 1½ -2 hours for 4-7 minutes.

The calf has to learn to follow its mother reliably before the cow-calf pair should go onto the outdoor enclosure. This may take 3-5 days.

It is recommended that a calf between 4 and 6 weeks of age be separated from its mother for short periods of time, e.g. 10 to 15 minutes for cleaning the stall. Determination of when to begin this training should be based upon the mother's disposition. With time, the length of separation should gradually be extended. Mother and calf will soon get used to it. It will facilitate the daily handling of the animals and will help to separate the calf during the rebreeding of its mother.

When the mother is in estrus, her milk production drops and she becomes irritable and temporarily disinterested in her calf. These behavioral changes are short-lived so intervention is not required. The calf will start to eat solid food within a few days, especially fruits. These attempts are more playful pastime than eating. Solid food will be ingested after about one month. For at least six months, it will stay dependent on its mother's milk at which time weaning is possible, but not desirable for any other than well-being issues. An infant should not be separated permanently from its mother before it is at least one year old.

Wait three to four weeks before giving a calf access to pools, especially when there are parts deeper than the calf is tall. During this 'dry period' shower the calf regularly with temperate water.

First defecation seems to take place between two and ten days of age, but is hardly ever detected. Since a calf often defecates immediately upon entering water, its feces are usually first seen by a keeper at this time. The calf's 'milk' feces are a very light brown roll that remains floating, and are noticeably different from an adult's dung.

It is normal for a calf to gain an average of 1.9 kilograms ( $n = 10$ ) per day for the first eight to ten weeks. But there are pretty remarkable individual differences; the increase in weight may be as little as 1.5 kilograms or as much as 2.2 kilograms.

Although rare, it is occasionally necessary to hand rear an Indian rhino calf. When there is a need, it most often arises out of the infant's failure to nurse, the mother's rejection of the calf, or medical problems of either the mother or infant. Hand raising an infant must be considered very carefully. And, unless the mother shows aggression toward her calf or has medical problems, the infant should always remain with its mother. Separation for bottle feedings is necessary only if the mother is kept hands-off (see 7. Hand Rearing).

### **3.4.6. Reproduction by Artificial Means**

To date the techniques for artificial insemination for the Indian rhino are still being developed. Great progress has been made in the last couple of years with Black and White rhinos.

Indian rhinos are quite easily bred, in contrast to extremely rare species such as the Sumatran rhino. So at this time pursuing artificial means of reproduction for Indian rhinos is not a priority. If, however, an easy and successful technique is developed, it could be used to further the efforts of greater gene diversity within the captive population as well as to introduce new genes from the wild, without additional animal removals, into the captive population.



## **3.5. MANAGEMENT**

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### **3.5.1. Identification**

Although the captive population is small and the Individuals can quite easily be identified, it is recommended to implant transponders soon after birth behind the left ear. Transponder identification numbers need to be reported to the studbook keeper. Distinguishing traits (such as scars, uncommon pigment variations, ear irregularities, etc.) should be documented through photographs and / or drawings. If an animal is transferred, these records, or copies of them, should go with the animal to the new facility.

### **3.5.2. Keeper Training and Interaction**

Indian rhinos can be kept hands-off or hands-on depending on the facility's policy, with enclosure design consistent with the chosen method.

In very large facilities the hands-off method is standard. In average sized zoos Indian rhinos can quite easily be kept hands-on, and in large facilities at least some hands-on training is recommended. A day-to-day, set-routine interaction with the animals will facilitate medical and foot care, introductions, births and separations. Usually Indian rhinos are quiet, gentle and easy to handle but they have their moments and show only subtle signs of growing irritation. The animals should not be taken complacently. It is crucial for an experienced keeper to teach keeper-trainees what to look and listen for and what action to take. A well-designed enclosure will provide many possible escape routes for keepers, especially considering rhinos are not very talented jumpers or climbers (see 4. Design of Enclosures and Housing). A keeper should always take a whip onto the enclosure (for cracking only and not for striking the animal). Although one keeper can handle the daily regimen on an outdoor enclosure, for safety reasons there should always be at least two staff members present when action must be taken in an animal occupied stall (for example, wintertime foot care).

### **3.5.3. Keepers' Regimen**

#### **3.5.3.1. The Daily Regimen**

- ? Ensure drinking water is always available and change it, if it is not supplied by an automatic fill or continuous flow device.
- ? Clean and disinfect the drinking trough to inhibit algae and bacteria growth.
- ? Provide straw and/or hay ad libitum and distribute the other food items (see 6.1. Food and Feeding) throughout the day in small portions.
- ? Clean natural substrates and hard-surfaced areas, by raking, sweeping or hosing as appropriate.
- ? Clean indoor housing surfaces.

- ? If it is necessary to keep the animals indoors for weeks at a time during the winter months, give animals permanently or at least once a day access to the indoor pool. When an animal does not have access to the pool due to technical or management reasons, it should, at least, be showered with temperate water.
- ? Indian rhinos are particularly sensitive to hay and straw dust; consequently, special attention needs to be paid to minimizing the dust in their environment (see 5.4.3. Lungs).
- ? Following a well-structured daily time pattern will facilitate the handling of the animals tremendously.
- ? In hands-on facilities, approach, caress and speak to lying animals often: this enables them to become familiar with your voice and touch, and it builds trust. This is very important for foot and veterinary care.
- ? Keep a daily log of animal behavior, needed maintenance and technical problems.
- ? This regimen is undoubtedly not practical for very large facilities with free ranging herds. Their requirements, such as the need to remove dung heaps, turn the soil and scatter manure to reduce parasitic loads, and so forth, are very different. They would best be dealt with by each facility based on their individual circumstances, like size of enclosure and herd, climate, etc.

### **3.5.3.2. Work to Do as Conditions Dictate**

- ? Change water in indoor and outdoor pools, timing dependent on number of animals, frequency of use, size of pool and climate.
- ? Provide, as often as possible, manipulative objects, hidden food items, hung browsers, and so on; varying, at least every few days, locations, times and applications (see 3.6. Enrichment).
- ? Mud wallows, although of great benefit to and absolutely loved by the animals, are stinky, ugly, fly attracting hygiene problems. Keep them as clean as possible and replace the really dirty parts regularly to prolong the intervals between renovations.
- ? Keep an enclosure's substrate in good maintenance to prevent health problems resulting from the ingestion of sand, pebbles or stones by an animal.
- ? Prepare for and be present at (or on stand-by for) introductions, births and transfers.

### **3.5.3.3. Seasonal Variations in the Regimen (in Temperate Zones)**

Indian rhinos should be left outside as much as possible, temperature permitting. To lock them outside, a minimum outdoor temperature of 10-15° C is required, with consideration given to sun, wind chill and rain. If exposed only for a short period of time (e.g. for cleaning purposes) in dry weather conditions, temperatures may be as low as 5° C. Do not let them out in icy conditions, not only because of frostbite, but also because of slippery footing.

In warmer climates, indoor housing is not essential, even when night-time temperatures get close to freezing, as long as daytime temperatures warm the animals up again (air temperature above 20° C) and there is shelter against rain and wind. Rhinos suffer from long-term exposure to temperatures around or below 10° C, especially when combined with rain, high humidity or wind chill. In these conditions indoor housing is vital and should be heated to 18-20° C, locally even to 24° C. Although the indoor temperature may drop to approximately 13° C during the night, it should heat back up to 18-20° C during the day, and with young calves to 22-24° C.

During the cold season, water pools should be drained (and eventually filled with substrates to avoid falls); mud wallows should be dredged out.

### **3.5.4. Offspring Management**

It is necessary for breeding facilities to have the space capacity for holding offspring for up to at least 3 years. Cow-calf pairs need to be held separately for a period of time after birth until such time that they may be reintegrated with the other female(s) (see 3.3.2. Reintroduction Cow-Calf). Male offspring may stay with their mothers and other females for 5 to 7 years, until they start displaying early sexual behavior and harassing the females. Young unrelated males who are ultimately to mate with the present females, should be held separately once they reach 5-7 years of age, when they start showing interest in females' dung heaps and begin spraying urine. If not separated, they might develop a 'mother-son' or a 'sister-brother' relationship with the females, which could cause behavioral problems at mating time. Ideally one would keep two young males of about the same age together until they reach sexual maturity and start fighting. Female offspring can remain in the herd, if in compliance with the studbook recommendations and if the breeding bull is not the sire.

### 3.5.5. General Breeding Recommendations

The following general breeding recommendations are based on the SSP<sup>®</sup> central dogma (Dee, Foote & Willis, 1994):

1. The first priority is to breed individuals of lowest mean kinship. The genes of these individuals are underrepresented and, therefore, these individuals possess the rarest alleles in the population.
2. Among individuals with low mean kinship, the second priority is to breed with those whose alleles may be lost soon, i.e. with individuals nearing reproductive senescence.
3. During pairing, pair individuals according to the following ordered criteria:
  - a) Mate individuals with roughly similar mean kinship to avoid combining rare and common alleles in offspring, which reduces long-term gene diversity
  - b) Mate individuals whose offspring will have low inbreeding coefficients for the best probability of viable, healthy offspring
  - c) Maximize mating success on the basis of the knowledge of age of individuals, mate-choice, social structure, etc.
  - d) Minimize logistic difficulties (distance and cost of transport of individuals, quarantines, interinstitutional conflicts, etc.)

### 3.5.6. Specific Breeding Recommendations

It is recommended that successfully breeding males becoming over represented in the gene pool be periodically exchanged with genetically important but so far underrepresented bulls, in accordance with the studbook keeper. Currently, the four best-represented founders have contributed more than half (53.3%) of all genes found in the living captive-born population. Therefore, breeding with individuals imported from the wild and with offspring from underrepresented founders should be encouraged; these individuals can be identified by their low mean kinship values (Samuel Zschokke, in Wirz-Hlavacek, 1999).

Although the number of Indian rhinos in captivity is still very low, an average birth interval of 3 years is recommended over a cow's reproductive life, with progressively longer intervals, as she gets older. Further, the female's estrus cycle will restart shortly after the delivery of a calf, but a wait of at least one year is recommended before re-breeding. A possible disadvantage to this yearlong wait without a new pregnancy is that during each estrus the cow may have short-term behavioral changes, becoming irritable and disinterested in her calf. It may also lead to a bull going berserk while the cow is in heat, especially if they are kept in close proximity to each other. So, re-breeding may be an option after 2 or 3 estrus cycles if you have an easygoing male. But, if there is a risk of serious injury during breeding because your male is young and rambunctious, it might be preferable to deal with the bull and wait the longer time period.

## **3.6. ENRICHMENT**

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### **3.6.1. Structural Enrichment and Furniture**

Enclosure design can be the first step toward animal enrichment with greater complexity creating more stimulation. A variety of structural features, like pools, mud walls, sprinklers, rubbing posts and rocks, visual barriers, dirt mounds, etc. will improve the potential for animal well-being. Manipulative items such as logs, laying or suspended, boomer balls, tires and large plastic drums for pushing, and whole trees fixed at one end on a raised rock or other hard surface for lifting by horn or shoulder will extend periods of physical exercise. Artificial items (balls, tires, drums) have the same enrichment value to the animals as natural ones but are questionable from the educational point of view. Care should be taken when introducing items to easily frightened or nervous animals.

### **3.6.2. Behavioral Enrichment**

The grouping of animals on an enclosure provides a very stimulating enrichment; in average sized zoos the grouping of females on a single enclosure and in the larger facilities by holding the male with the females. A calf will generate much interest and activity; consequently its inclusion in the group, as soon after birth as possible (see 3.3.2. Reintroduction of Cow-Calf), is encouraged. Where males are held separately, further enhancement comes from enclosure swapping between the male(s) and female(s), with dung heaps left in place. In the least, allow male-female visual contact and olfactory access.

Food is an ideal enrichment tool. Although Indian rhinos are more grazers than browsers, browse branches and mulched branches spread throughout the enclosure will keep rhinos busy for a long time. (Make sure that no poisonous species like *Acacia* have been mulched.) Miscellaneous food items hidden in the substrate, with time and location varied, will also help keep the animals occupied. Hide food on hard surfaces that are covered with mulched branches to avoid the ingestion of sand or pebbles while the animals are digging for the hidden items (Neugebauer, 2000). Food, like apples, beets or salad, floating in the water pool will often evoke play behavior, especially in calves and subadults. Branches fixed in solid steel or concrete tubes in changing locations on the enclosure will keep the animals busy much longer than browsers lying on the floor.

Also operant conditioning training (see 3.8. Rhinoceros Training) can be a nice additional change in the animal's daily routine.

### 3.7. MIXED-SPECIES EXHIBITS

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Some facilities have successfully created mixed-species exhibits, including birds and hoofstock, on outdoor enclosures. It is critical that there is sufficient exhibit space structured with adequate refuge areas and visual barriers. The dispositions of the individual animals involved are also crucial.

At 'The Wilds' in Cumberland, Ohio, they kept single Indian rhinos together with a wide variety of hoofstock, e.g. a female IR with Bactrian camels, Onager, Urial sheep, Pere David's deer and Banteng (on 25 hectares), or an IR bull with Bisons, P-horses, Pere David's stags and male Musk ox (on 50 hectares). Except some playful chasing of a Banteng by the cow, no interspecific interactions were observed, (Mark Jacobs, pers. com., 2000).

### 3.8. RHINOCEROS TRAINING

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There are, of course, different levels of training, from getting the animal used to being touched to having it obey voice commands to ultimately a full operant conditioning program (OCP). Fouraker and Wagener in the *AZA Rhinoceros Husbandry Resource Manual (1996)* describe both voice commands and operant conditioning in length. Indian Rhinos seem to be as trainable as other rhinos; therefore, there is nothing specific to Indian rhinos to add. A high level of training will definitely help to facilitate procedures like blood collection, ultrasonic tests and general veterinary care. But to date, at least in Europe, only few institutions run a full OCP, because it requires time, much coordination and cooperation among staff members, and a lot of expertise.

Nonetheless, a few basic training steps, helpful in daily handling and foot care, can easily be accomplished.

Rhinos are very 'conservative' animals; therefore, consistency in daily routine and training is paramount. Basic training should first be carried out by the person closest to the animals, usually the head keeper. Once the commands are reliably executed, additional personnel may be included.

For daily handling teach your rhinos a few basic commands. Fouraker & Wagener (1996) recommend the following voice commands:

Move up	to make the rhino move forward
Back	to make it move back
Over	to make it step over
Steady	to make it hold its position
Come	to make it come to the keeper
Foot	to make it present its foot
All right	to release the animal

Of course, you can use any kind of commands, as long as you use them consistently and as long as they are easy to distinguish. It might, nonetheless, be helpful to use these standard commands (even in non-English speaking countries), to avoid a mix of 'command languages', when animals are transferred to other institutions.

Only train one animal at a time. Always start the training at the same time and in the same specific part of the enclosure. Work for ten to thirty minutes per day per animal. Train a command until it is reliably executed before using it together with other commands. Reward the animal with apples, carrots, bananas, pellets, etc., whenever it performs the desired behavior or at least an approximation of it. Always combine a reward with an affirmation like 'good' or 'well done' and, if possible, with a tactile stimulation like caressing or patting. (Many Indian rhinos love being stroked between the front legs, in the skin folds behind the shoulder or between rump and hind legs.) Do not reward if another behavior is performed, even if this behavior is performed correctly. Only reward during the training sessions.

If your institution runs no training programs at all, at least make sure foot care can be performed without sedation (see also 5.1. Foot problems). With this aim in mind, use every opportunity when an animal is lying on its side, to approach it. Talk to avoid startling it. Reward it when it stays down. Start touching, patting, rubbing and caressing the animal and reward it when it lets it happen. Lean on it (with the necessary respect, they are incredibly fast when getting up!). When the animal gets more and more familiar with this close contact and relaxes (which may take weeks), include another person, still without performing any foot care. Only when the rhino 'trusts' both people (no quick head rising, no snorts, no standing up), may you start working on its feet. Make sure you do not touch sore spots during the first couple of treatments. The second person feeds and caresses the animal and watches for signs of annoyance, because the person working on its feet has to concentrate on his or her work. Females relax when you knead their teats; in males you caress the preputium. But when doing so beware of the hind legs: rhinos can kick very violently and incredibly fast should the treatment hurt.

## 3.9. SHIPPING PROTOCOL

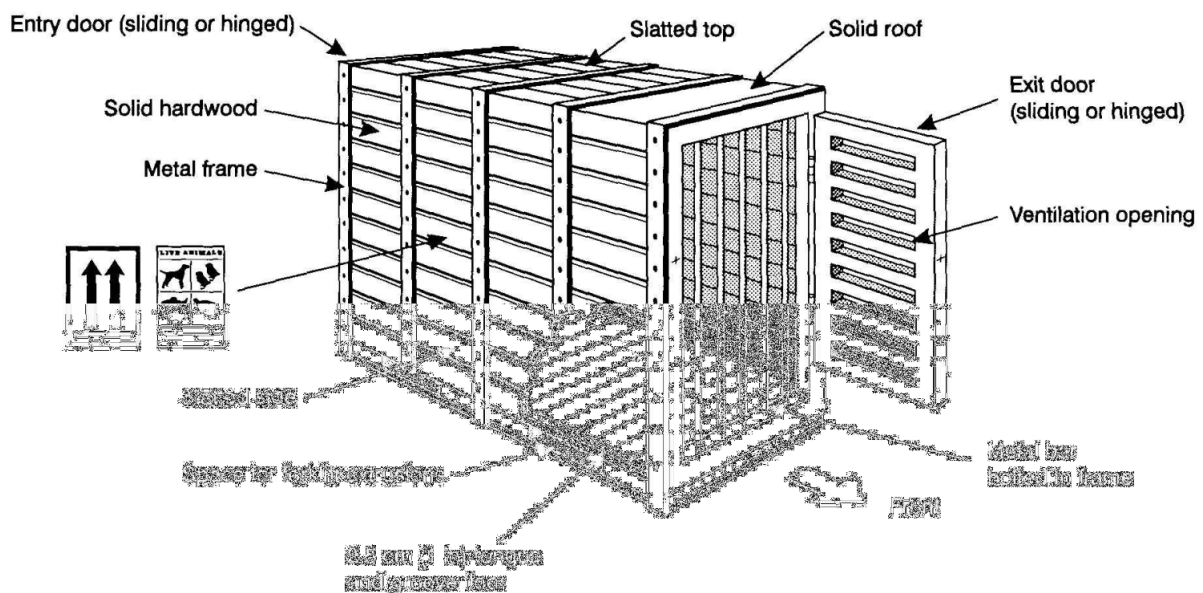
Adult Indian rhinos are extremely powerful, with average males weighing from two to three tons. Do not attempt to force them into a crate. It is highly recommended to either go through crating training or sedate / tranquilize the animal before the procedure.

### 3.9.1. Pre-Shipment Legal and Medical Procedures

As an Appendix I species, Indian rhinos require CITES export and import permits. The international traffic of rhinos, as odd-toed ungulates, is relatively simple compared to even-toed ungulates. Most governments require no or only very few medical examinations. Some may ask for TB tests, brucellosis serology, fecal screens for salmonellosis or endoparasites. In special cases vaccinations for clostridial diseases, leptospirosis or rabies may be required.

### 3.9.2. Design of Crate

This paragraph and the construction plan have been taken from the IATA Live Animals Regulations (2001) with only slight modifications (see bottom of paragraph).



The International Air Transport Association (IATA) defines the crate design specifications. Check the newest specifications when planning a transport; they are regularly reedited. Crate dimensions are determined by an animal's size.



### **3.9.2.1. Materials**

- ? Metal & hardwood

### **3.9.2.2. Principles of Design**

- ? Strong metal frame lined with solid hardwood sides. Vertical metal bars<sup>1</sup> should be bolted in place at entry and exit with sliding or hinged wooden doors on the exterior of the bars. The upper third of the wooden doors must have ventilation spaces or openings. IATA specifies that the roof must be solid over the animal's head<sup>2</sup> and slatted over the loin and hindquarters for ventilation.
- ? The interior must be smooth with no projections.
- ? Entry and exit doors must be closed and bolted in strategic places to be strong enough to resist the animal<sup>3</sup>.
- ? The floor must be at least 2.5 cm thick tongue-and-groove or its equivalent and be provided with a smooth but non-slip surface.
- ? For airline transport, the container must be constructed in such a way that the floor and lower sides are leak-proof<sup>4</sup>.
- ? In view of the diversity in size, strength and temperament of the individuals, the size and strength of the container must be sufficient to restrict the movement of and restrain the animal. Dimension must be large enough to prevent cramping without allowing unnecessary movement. In general the crate should be 30 cm longer and wider than the animal when it is lying on its side.
- ? Only nuts and bolts should be used in the construction of the container.
- ? At the front of the container, there must be provisions for water and food access at the base of the door and between the bars, if present. This access point must be clearly marked FEEDING and be adequately secured when not in use.
- ? A water container must be provided and must be sufficiently large for the entry of the animal's muzzle.
- ? Entrance and exit must be clearly indicated.

### **3.9.2.3. Recommended Modifications**

<sup>1</sup> The crate's design should allow for the vertical bars at the head end to be inserted individually (see below, 3.9.3. Crating Training), with a heavy-duty security device keeping them from slipping out.

<sup>2</sup> Indian rhinos develop an incredible power when they slam their head and horn upwards. Make the roof above the head VERY strong and solid! Thick plywood would be a good choice.

<sup>3</sup> The wooden exit door with the ventilation openings should hang in hinges that can be opened on both sides, making it possible to remove the door completely. This is important when the crate stands in the confined space of a cargo airplane with no room for swinging the door open.

<sup>4</sup> Most airlines will require a waterproof crate because of the amount of urine. This is difficult to achieve in the heavy crates needed for rhinos. Discuss in advance the possibility of putting the crate onto a heavy plastic foil or a tarpaulin, covered with wood shavings or sawdust, which is tied up half a meter around the crate.

### **3.9.3. Crating Training**

Crating training should always be given preference to sedation / tranquilization. Indian rhinos are always eager to eat and will do almost anything for a tidbit. Intensive training will require 7 to 14 days, depending on the animal's personality and its general level of training, whereas, acclimation done by the keeper in addition to his normal daily regimen will take up to six weeks. It is recommended that the trainer / keeper accompany the animal during the whole transport.

If you have the structural possibility, let the animal move from the indoor housing to the outdoor enclosure through the crate, opened on both ends, heavily strutted, and fixed so it cannot be moved. The animal should not have access to the sides of the crate from the outside.

As the first step of acclimation, let the animal just walk through both ways for a couple of days. It helps tremendously when a trainer permanently stays with the animal, coaxing it with voice commands and giving additional rewards combined with affirmations like 'good' and patting (see 3.8. Rhinoceros training), whenever the animal walks through. Later make it stop in the crate by offering preferred food items like browse, apples or bananas. It is essential to have a crate with heavy steel bars at the forward end, which can be inserted one by one (see 3.9.2. Design of Crate). Train the animal to hold position in front of a single steel bar leaning against the frame in the center of one of the openings (voice command 'steady'), reward it, take away the bar and make it move forward and out again (voice command 'move up'). Increase the number of bars. Include two staff members in the training program as soon as the animal reliably executes these steps, both will be needed to close the entry door of the crate once you really get serious. It is paramount that only these three people, the trainer and the two staff members, are present during the actual crating process: no trucks, forklifts, journalists, cameras, flashlights, etc.!

If a walk-through situation is technically not possible, fix the crate securely along an enclosure wall and make sure all metal frame parts and bolts are covered, rounded or flattened, because the animal might take the crate as structural enrichment and try to move or lift it. Next, give the animal its daily amount of grass, hay, straw and browse near the crate's entrance, gradually moving it deeper and deeper. Continue as described above.

### **3.9.4. Crating with Chemical Sedation / Tranquilization or Immobilization**

For completely untrained and especially for 'hands-off' animals sedation / tranquilization with an anxiolytic agent (Diazepam, Acepromazine or Haloperidol) might be helpful. You may also want to keep a certain level of tranquilization during the whole transport to avoid self-damaging hyperactivity (see 5.9. Sedation / Anaesthesia).

Full immobilization (e.g. with etorphines like M 99<sup>®</sup> or LA Immobilon<sup>®</sup>) should only be chosen if all other alternatives have failed, because the gentle handling of a lying two ton animal would be rather difficult and pushing it into a narrow crate would hardly be possible without causing abrasions or even more serious damage. Minor immobilization, where the animal can still walk, is a dosage problem (see 5.9. Sedation / Anaesthesia), but with some experience it seems to work pretty smoothly (Fouraker & Wagener, 1996). However, after an immobilization, an animal should be observed for renarcotizing symptoms for 24 hours, before it is loaded for the transport, or a veterinarian should accompany it.

### **3.9.5. Transport**

At least a light tranquilization of an animal is recommended for transports taking longer than a couple of hours. Even a quiet animal tends to throw tantrums when annoyed; and can easily injure itself, even break its horn, when banging its head against the roof of the crate.

Adequate climatic conditions during transport are important since Indian rhinos (especially if sedated or tranquilized) may develop a thermoregulation problem. Therefore, use open trucks only for short distances in moderate climates. For longer land transportation and in very hot or cold weather conditions, an enclosed, climate controlled truck is necessary. Air transport is recommended for trans-oceanic relocation because ship transport takes too long.

Do not accept aluminum air cargo boxes. They would lead to overheating and ventilation problems.

Make sure in advance that the cargo hold of the airplane will be heated. Freighters often cool the hold because of perishable goods like vegetables or fruits.

Accompanying keepers or trainers should carry the necessary amounts of tranquilizers (see 5.9. Sedation / Anaesthesia), in case the animal gets annoyed or excited. Indian rhinos will always accept tidbits, even in a state of heavy agitation. Therefore, oral application of a tranquilizer, for instance in a banana, is pretty simple.

Carry large amounts of carrots, apples, bananas, hay, etc., because you can always soothe even a very bad-tempered Indian rhino with a considerable load of favorite food. Be careful with food if the animal has been sedated / tranquilized for crating. Check first with the responsible vet. Also, large quantities of water are important, not only for drinking, but also for showering the animal, if necessary, to cool it down.