

Hand-rearing Black and White Rhinoceroses: A Comparison

by

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Abstract

The San Diego Wild Animal Park is home to one of the larger populations of captive rhinos representing three different species. As such, we have been successful breeding these animals. There are occasions, rare though they may be, which require that rhino calves be pulled for hand rearing. Since 1995, the Animal Care Center at the Wild Animal Park has had the opportunity to hand-rear two Eastern black rhinos (*Diceros bicornis michaeli*) and two Southern white rhinos (*Ceratotherium simum simum*). Prior to this time period the last black rhino was hand-reared in 1976 and the last white rhino hand-reared in 1988. While unusual that this number of calves have required hand-rearing recently, the staff of the Animal Care Center or the ACC, the Zoological Society of San Diego's nutritionist, and the veterinary staff have utilized these opportunities to learn more about these two species and refine the techniques used for hand-rearing.

Introduction

The reasons for hand-rearing of these four individual rhino calves vary. The Eastern black rhino calves were both pulled for medical reasons and the Southern white rhino calves for maternal neglect. Jomo, a male Eastern black rhino born on 22 July 1995, is the offspring of Cornelius and Judy. His front legs were weak and required casts for support. Jambia, a male Eastern black rhino born on 24 February 1997, is also the offspring of Cornelius and Judy. This calf was born late in the evening on a cold night. His was a normal, easy birth and he was almost able to stand but then got very cold. His temperature was 82° F when received at the care center. He was also hypoglycemic at this time.

Mbolo, a male Southern white rhino born 5 September 1998, is the offspring of Chuck and Mfolozi. He is a rather unusual case as he is the fourteenth calf from this dam. Prior to this calf, Mfolozi had been an attentive dam. There was a calf born in June of 1998 to another Southern white female, Komaas, and Mfolozi attempted to adopt this calf shortly before Mbolo was born. When he was born, the dam showed no interest in him and he was pulled. Uhuru, a male Southern white rhino born 2 March 1999, is the offspring of Chuck and Ujima. Ujima is a first time dam and was only four years of age at this birth. She initially showed signs of caring for the calf but the adult male, Chuck, was harassing her and she then neglected the calf. Ujima was also born at the park making Uhuru the first second-generation Southern white rhino born at the Wild Animal Park.

Formula protocols

Rhinoceros milk is more dilute than milks of other ungulate species. It is low in solids and proteins, very low in fat, and high in sugar (Oftedal, 1984). While different than rhino milk, non-fat and low fat cow's milk can be used as an appropriate substitute with the addition of other ingredients. Cow's milk is low in iron and an iron source is added to the formula once per day.

Vi-Sorbin is the product used at the ACC. Lactose (powdered, edible grade) is used to increase the sugar content. Dextrose (reagent grade) may be substituted for the lactose. Lactose is preferred, as that is the type of sugar found in rhino's milk. The feeding regimen will vary over time in terms of type of formula offered and number of times per day (see Table 1).

Table 1. Rhino Formula and Feeding Guidelines

Age	Formula	Ratios	Feedings per day ¹
1 day old	100% cow's colostrum		7 times, every 2 hrs.
2 days old	NFC:LFC:Lactose:H ₂ O w/ 50% colostrum	27:9:1:1 ²	7 times, every 2 hrs.
3 days to 1 month early lactation formula	NFC:LFC:Lactose:H ₂ O w/ 10% colostrum	27:9:1:1	7 times, every 2 hrs.
1 - 3.5 months early lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:1	5 times, every 3 hrs. ³
3.5 - 6 months mid-lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:2	4 times
6 - 9 months mid-lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:3	3 times
9 - 12 months mid-lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:4	3 times
12 - 15 months late lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:6	2 times
15 - 18 months late lactation formula	NFC:LFC:Lactose:H ₂ O	27:9:1:8	2 times

NFC: Liquid non-fat cow's milk (skim milk)

LFC: Liquid low-fat cow's milk (1% fat)

Lactose: powdered, edible grade; can substitute dextrose (reagent grade) for the lactose

¹ day consists of a twelve hour period from 6 am to 6 pm

²27 parts NFC to 9 parts LFC to 1 part lactose to 1 part water

³at roughly two months of age the calf can go to 4 times per day

For the first twenty-four hours 100% cow's colostrum is fed. This provides the calf with intact immunoglobulins (antibodies) which they would have received from the dam's milk. Do not overheat the colostrum as this will destroy proteins. Make the transition to formula over the next twenty-four hour period by feeding 50% colostrum and 50% formula. For continued gastrointestinal protection the calf is fed 10% colostrum and 90% formula for the next four weeks. Formula is offered at a rate of 15-20% of the body weight per day. The daily volume offered is maintained when dropping a feeding until the weaning process begins. Weaning begins at approximately one year of age with a target wean date of approximately eighteen months. The formulas are designed to come as close to rhino milk as possible in terms of composition during early, mid-, and late lactation periods (see Table 2).

This protocol is used as a guide and can be adjusted as needed to suit individual animal's needs. When mixing the above formula, reconstitute the lactose (measured by weight) with water (measured by volume) following the values in the ratio column. Lactose will readily go into

solution by heating the water. This can be made up in advance and added to the formula when cooled. Weigh out the lactose/water stock for the formula.

Example: NFC 1350 ml
 LFC 450 ml
 Lactose/water stock 100 grams*
 Approximate total 1900 ml

*Note: 100 grams of lactose/water stock is not 100 ml.

Table 2. Percentage Composition of Rhino Milk and Formula

	Total solids	Fat	Lactose	Protein	Ash
White rhino* sample A	8.84	0.60	6.50	1.54	0.20
White rhino* sample B	8.26	trace	6.85	1.18	0.23
Black rhino**	8.10	trace	6.06	1.54	0.34
27:9:1:1	11.39	0.38	5.63	3.20	0.72
27:9:1:2	11.09	0.37	5.48	3.12	0.70
27:9:1:3	10.82	0.36	5.35	3.04	0.68
27:9:1:4	10.55	0.35	5.21	2.97	0.66
27:9:1:6	10.06	0.33	4.97	2.83	0.63
27:9:1:8	9.62	0.32	4.75	2.70	0.60

*Data from Wallach, 1969. Sample A is a cow with a five month calf; sample B is from a cow with an eighteen month old calf.

**Data from Aschaffenberg, et al., 1961. This sample is from a cow with a nineteen month old calf.

Jomo, Mbolo, and Uhuru were or are being raised on this formula and schedule. Jambia was raised on a slightly different formula. This change was based on information gained from a collaboration that our nutritionist (second author listed above) had with the staff of Fossil Rim Wildlife Center on black rhino milk analysis. The staff from Fossil Rim was able to milk a black rhino for a period of one year and analysis of these samples showed that rhino milk had a lower percentage of solids than did the formula. Formula components remained the same for Jambia, but the ratios were adjusted (see Table 3).

Table 3. Jambia's Formula Schedule

Day	NFC	LFC	Dextrose	Water
8	27	9	1	1
26	18	9	1	4
31	18	9	1	8
36	9	9	1	10
95	9	9	1	5

These formula ratios lowered the percentage of solids without affecting the other primary components. This formula was more dilute than the other and as was learned did not fill up the calf as readily. Prior to day 8, Jambia was receiving dam's milk mixed with formula, as the field crew was able to milk Judy before she dried up. Jomo also received dam's milk before going to straight

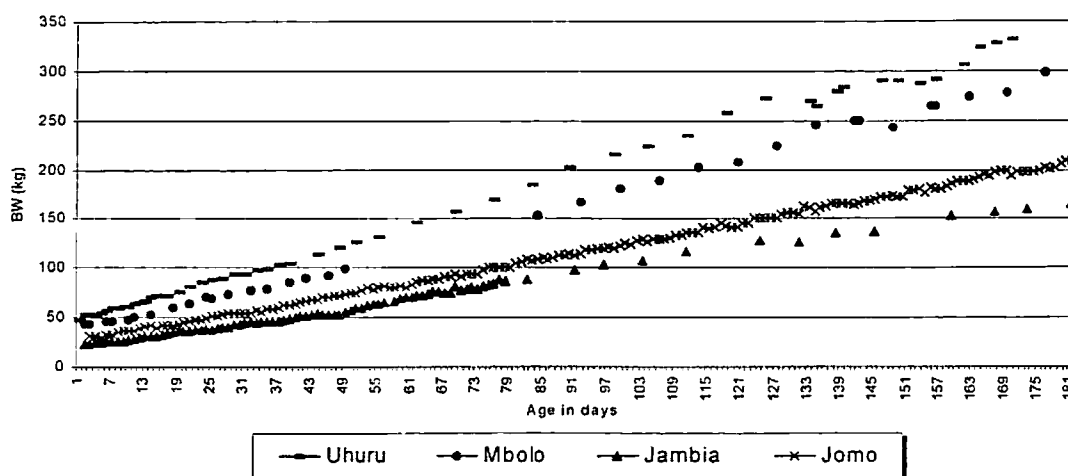
formula. It was not possible to milk either Southern white rhino dam so neither Mbolo or Uhuru received dam's milk.

Herbivore pellets, grains, acacia (*Acacia saliana*) browse and alfalfa hay were made available from the second week on. Once they started getting their teeth, an effort was made to place food in their mouths to encourage them to pick up solids. Tooth eruption began at roughly 1 week of age in black rhinos and roughly 1 month of age in white rhinos.

Growth

Rhinos in general tend to grow at a very fast rate. Depending on the species, it's not unusual for the calf to put on 25-50 kg per month for the first year of life. Black rhinos, being a smaller species, would not put on as much weight as the white rhinos. The Eastern black rhino calves, over the first six months of life, averaged 0.98 kg/day for Jomo and 0.79 kg/day for Jambia. Mbolo averaged 1.53 kg/day for the first six months and Uhuru averaged 1.79 kg/day for the first four months (he had not reached six months of age as of this writing).

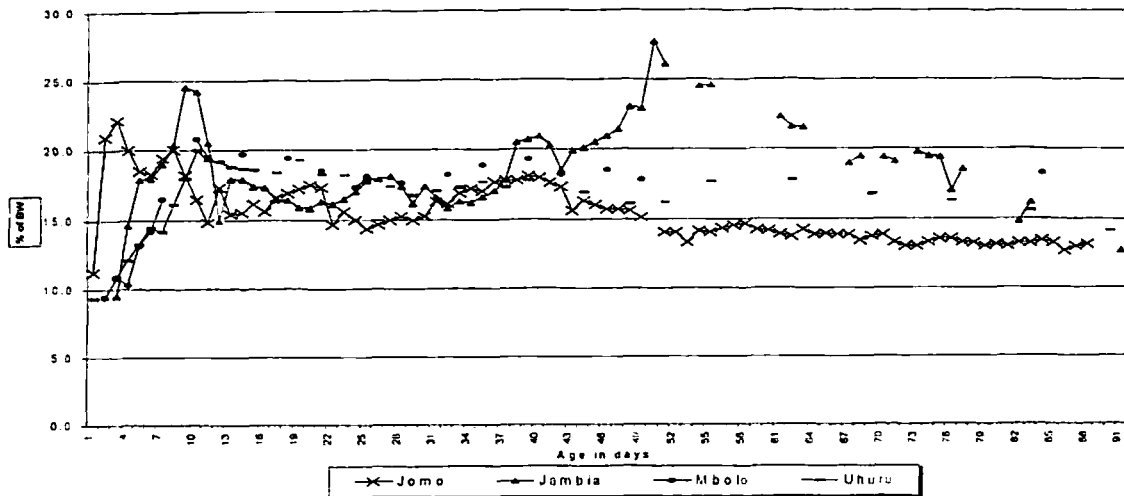
Chart 1. Rhino growth



In the first six months, both the Eastern black rhinos and the Southern white rhinos gained weight in an almost linear fashion (see chart 1). However, both white rhino calves started to have a definite upward trend in their growth at approximately sixty days of age. The black rhino calves' growth tended to stay more constant over time.

Formula was offered at the rate of 15-20% of their body weight per day. This was used as a guideline and the amounts did vary (see chart 2). Jambia reached the highest percentage at 27.7%. If the rhinos appeared hungry or frantic for formula then the percentage would be increased until they appeared satisfied. Instances of dirt eating occurred when these animals were not satisfied at their current amounts. Dirt eating was carefully monitored and when instances occurred, psyllium was added to their bottles to aid in moving the dirt through their systems.

Chart 2. Intake Percentages



Medical Problems

There were few medical problems encountered with any of these calves. Jomo came to the ACC with casts on his front legs because they were weak and would buckle under when standing after he was born. His rear legs were weak as well but did not require casts. Once the casts were removed, his legs continued to get stronger and he progressed normally and did not require any further support. His legs were in casts for less than a week. His primary problem while in the ACC's care was constipation. He was given several warm water enemas, which were successful, and he also, at times, received psyllium in his bottle twice a day to encourage the passage of stool.

Jambia encountered more medical problems than Jomo as he came to the ACC compromised. His temperature was very low (82° F) and he was also hypoglycemic requiring IV therapy. This therapy consisted of 5% dextrose in water, which was switched to 7.5% dextrose in water overnight, for the first night. He continued on 5% dextrose in water IV for five days. The first day he also received steroids IV as well as 50% dextrose. Antibiotics were prescribed for five days as a precautionary measure. Once over this initial hurdle, his primary problem came to be constipation as was seen in Jomo. He received several enemas to aid in stool passage. Psyllium was also given and was also added to his bottles when he developed a dirt eating habit. This was done as a precaution against sand in the stool.

The Southern white rhinos did not have the problems with constipation that the Eastern black rhinos had. Both white rhino calves, however, encountered problems with *Giardia lamblia*. Mbolo was diagnosed as *Giardia* positive as well as *Campylobacter spp.* positive at the same time. This initially manifested itself in the form of diarrhea and appetite loss. Until stool cultures came back with results, he was treated with antibiotics and a wormer as a precaution. The antibiotic helped to combat the campylobacteriosis. Once giardiasis was diagnosed, he was started on a proper treatment regimen. On recheck he was negative for both. All medications were given in his bottles with little difficulty.

Uhuru was also diagnosed as *Giardia lamblia* positive. He was treated and on recheck was negative for giardiasis but his diarrhea persisted. Several other tests were run to determine if another disease organism was at work but all tests came back negative. His formula was changed to a dextrose formula instead of lactose. It was thought that perhaps the enzyme, lactase, found on the villi in the gut had been stripped away during his initial bout with diarrhea rendering him unable to properly digest his formula. It was hoped that by changing him to dextrose, which is broken down by another enzyme, that this would allow the lactase to replenish. His diarrhea did not readily resolve and as of this writing was still not completely resolved although it is much improved. Unlike Mbolo, there was no appetite loss in Uhuru. He continued to eat normally although his attitude became somewhat depressed. His medications were given in his bottles with no trouble whatsoever. Uhuru would also on occasion eat dirt. This occurred during growth periods and, with the addition of psyllium to his bottles, there were no problems encountered.

Socialization

One of the more important elements in the hand-rearing process is the socialization of the calf. Socialization helps alleviate neurotic behaviors in the calf and eases reintroduction to conspecifics at a later date. This also helps to ease the dependency of the calf on its human caretakers. Whenever possible, a companion animal is placed with the rhino calf. It is best that the companion be a large animal, as rhinos tend to play rough. In addition to providing companionship for the calf, the companion animal helps to exercise the calf. Exercise is essential to proper bowel movement. Rhino calves will run along side keepers but usually do not exercise much on their own until older. As keepers cannot be with their charges twenty-four hours a day, the companion animal provides the needed stimulus to get the calf up and moving. When initially brought to the ACC for hand-rearing, the calves were kept isolated from other animals for 1-2 weeks. They were considered "scrubbies" during this time period which meant keepers wore gloves, booties, and coveralls when dealing with the calf. This was to prevent any cross-contamination from other animals being hand-reared. Since a companion animal cannot be provided at this time, a stuffed hippo was left in the stall with the calf and provided the young animal with a companion until such time as the calf comes out of isolation. (Note: Make sure that whatever stuffed animal is used, it is fairly large and definitely washable.)

Neither Eastern black rhino calf had an animal companion initially when being hand-reared. There were no suitably sized animals being hand-reared at the same time as they were. Jomo had fewer behavioral problems during this time period than Jambia. Jambia developed a dirt-eating problem early on and had to be moved to another holding area in the facility which had a grass substrate rather than DG to alleviate this problem. To help in the transition from the ACC to living with less keeper contact, it was decided to bring up a domestic goat from the Children's Zoo at the San Diego Zoo as a companion animal. Aja, a Cashmere goat (*Capra hircus*), was then brought up and introduced to Jambia. First introductions were a little rocky, but the goat quickly learned to get out of the rhino's way. Unfortunately the move to grass could not be a long-term holding area and Jambia and the goat were moved to a holding yard at the black rhino exhibit area. This area's substrate is dirt. Since the goat did not initially appear to be fulfilling the roll of companion it was decided to ship the goat back to the San Diego Zoo and they were separated for a short time. During this separation Jambia resumed eating dirt and it was decided to try the introduction once again. When reintroduced, Jambia's dirt eating decreased and the goat was left with him. These

two animals never formed a very close bond with one another but it now appears the goat is far more attached to the rhino than the rhino is to the goat.

Mbolo's animal companion was a female gaur (*Bos frontalis gaurus*) calf that had come into the ACC at about the same time. There was also a wisent (*Bison bonasus*) calf and a water buffalo (*Bubalus bubalis*) calf housed at the ACC as well. The water buffalo and wisent did not live with the rhino twenty four hours a day but were put together with the gaur and the rhino for several hours a day in a large yard for exercise. The rhino would challenge all three calves to which the gaur and water buffalo were basically oblivious or would simply move out of his way. The wisent, once a little larger, would actually go head to head with the rhino in play sparing. Mbolo and the gaur associated much more closely than Jambia and the goat and would lie together. Once the gaur was weaned, it was attempted to leave her with him as a companion but she proved to be a handful to the keepers and she was removed. Mbolo had a depressed attitude once she was gone even though he continued to associate with the wisent and water buffalo for several hours per day. He had not bonded with them as he had the gaur. It was not possible to house them together overnight because Mbolo would charge the water buffalo when she entered his stall. Despite his apparent unwillingness to share his stall with them, when separated from them and housed alone he would vocalize for long periods of time. He was given access to the stuffed hippo to help ease the transition and was often found sleeping on, next to, or using it as a pillow. Once he was too big to be housed at the ACC, it was decided to try to introduce him to Jambia at black rhino holding. Mbolo was moved to black rhino holding at just over six months of age. When initially introduced there was no real aggression and Mbolo would defer to the larger rhino. The two did not associate very much in this introduction period preferring to stay away from each other. Mbolo was also not fond of the goat and would charge when Aja ventured too close. However after approximately a week of being housed together, Mbolo developed diarrhea once again and a stool sample showed he was *Giardia* positive. He was separated from Jambia because it was felt that perhaps the situation was stressful for him, which led to a flare-up of giardiasis. This separation was also done to prevent Jambia from contracting giardiasis. After treatment, a reintroduction occurred roughly 3 weeks later, with Mbolo now being removed from Jambia at night. This nightly separation lasted about one week and then they were allowed to live together twenty-four hours per day. The reintroduction went very smoothly and they began to associate more with one another. Mbolo also would not back down to the larger Jambia as often. He still did not like the goat though. Mbolo and Jambia now closely associate with each other often lying next to one another when dozing.

Uhuru also had the stuffed hippo as a companion while he was in isolation. He would lay against it and use it as a pillow. During the first two weeks of his life, discussions among the staff occurred as to what sort of companion to give him. There were no large animals currently being reared at the ACC except for a Grevy's zebra (*Equus grevyi*) and a Somali wild ass (*Equus asinus somalicus*), both of which were deemed unsuitable as companions for him. They were both considerably older and the zebra in particular was a very flighty animal. The zebra and Somali wild ass were housed together and there was no wish to separate them from each other. When Uhuru was about two weeks of age, the ACC received a Patterson's eland (*Taurotragus oryx pattersonianus*) calf for hand-rearing. She was not pulled specifically as a companion but had been a dystocia birth. It was felt that she would make a suitable companion for him and once her isolation period was over, an introduction took place. Initially they were wary of one another with the eland assuming a head down position. She was clearly not going to be intimidated by the rhino.

For two days their interaction occurred only during the day and they were not housed together overnight. Once it was felt that they could safely be left together, they were housed in the same stall. There was not much association with each other initially although when one would get excited and run this usually led to the other following suit. While in the smaller stall off exhibit the rhino did not want the eland lying near him and would force her away from him. Gradually over a period of a few weeks they began to lay together and associate more closely. Once the Patterson's eland was weaned it was decided to keep her at the ACC for as long as safely possible to keep Uhuru company. Fortunately for the staff she is not as pushy as the gaur and as of this writing is still housed with Uhuru at the ACC.

Present disposition

At present, three of the four rhinos are still housed at the San Diego Wild Animal Park. Jomo was shipped to the Pittsburgh Zoo at just over one year of age. Mbolo and Jambia reside together along with the Cashmere goat, Aja, in an off exhibit holding area. Uhuru as of this writing is still housed at the Animal Care Center along with the Patterson's eland.

Discussion

Black and white rhinos do not differ significantly at least in terms of hand-rearing. Both species have milk that is similar in composition. The same formula can be used effectively for both types of rhinos. Jomo, Mbolo, and Uhuru were all raised on the same formula. Jambia's formula was more dilute than that of the other three. This more dilute formula did not appear to affect the growth rate as Jambia's rate almost mirrors that of Jomo (see chart 1) in being very linear in fashion. The major difference with the more dilute formula was that his overall intake percentage was higher (see chart 2) and there were more instances of dirt eating when he was not satisfied. This formula did not appear to fill him up as effectively as the more concentrated formula. When Mbolo was pulled for rearing this was taken into account and he was switched back to the more concentrated formula. This was also the case with Uhuru. There were fewer instances of dirt eating in these two animals. The white rhino growth rates are linear in fashion as well and mirror that of the black rhinos until roughly days 51-60 when there is a definite upswing in their growth rate (see chart 1). Being a larger species this is to be expected. The black rhinos picked up eating solids much sooner than the white rhinos did. Tooth eruption occurs sooner in the black rhinos than in the white rhinos. First teeth appeared at about a week of age in the black rhinos and roughly one month of age in the white rhinos. The first instances of solid consumption were at approximately one month of age in the black rhinos and three to four months of age in the white rhinos. Since the black rhinos did not have companion animals, keepers made an effort to place solid food in their mouths. This was also done with the white rhino calves but to a lesser degree as they had companion animals and it was hoped that they would mimic their companions in this respect. Whether placing the food in their mouths led to the black rhinos picking up solids earlier than the white rhinos is speculation at this point. This was also done with the white rhino calves but to a lesser degree. It could simply be species differences.

There were not significant medical problems encountered with these animals. The major problem seen in the Eastern black rhinos was that of constipation. Since exercise is necessary for proper bowel movement it is not surprising that these animals developed this problem. The black rhinos had much more limited access to larger exercise spaces than did the Southern white rhinos. The black rhinos also did not have companion animals with which to socialize and the stimulus for

getting up and moving was not there. Significant effort was made to get these animals up and exercising but with other animals to care for it was simply not possible for keepers to spend as much time as necessary with these two animals. The white rhino calves both had companion animals and more access to large exercise areas and constipation was not an issue with them. The major problem seen in the white rhino calves was that of giardiasis, and additionally campylobacteriosis in Mbolo. White rhinos are grazers and black rhinos are browsers. The white rhino calves spent more time with their mouths to the ground than did the black rhinos. Mbolo and Uhuru were continually putting their mouths on anything and everything on the ground. They were especially fond of any puddle of water on the ground and preferred to drink from puddles rather than water tubs if puddles were available. Both *Giardia lamblia* and *Campylobacter spp.* survive in moist environments such as dirt or DG and this is probably where the white rhinos picked up the organisms. Since black rhinos are browsers, the two black rhino calves did not spend as much time mouthing objects on the ground or drinking from puddles.

Socialization was very different for these four animals. The black rhino calves did not have companion animals initially and were far more dependent on their keepers and, to a much lesser degree, the public for stimulation. Aja, the goat, seemed to help Jambia as his dirt eating decreased when the goat was reintroduced to him. As he was older at this time, the dirt eating is believed to have been behavioral in origin and not linked to hunger as in his initial bouts of dirt eating. In comparing temperaments it is difficult to say whether they are significantly different as the black rhinos were raised without companions and became more dependent on their keepers. The white rhinos each had companions and were not as dependent on keepers for daily stimulation. Among individuals of a species there were definite differences. Of the two black rhinos, Jomo was far more dependent on keeper interaction as he was raised completely alone. Jambia eventually had a goat for company and because of his dirt eating habits had to be removed from the ACC at an early age and therefore did not see his keepers as often. The two white rhino calves did not differ significantly in temperament from each other. Neither Mbolo or Uhuru were completely dependent on their keepers for interaction and often would wander away from the keeper after feeding was done or fun toys (i.e. trash bags, rakes, and scoops) were put away. Frustrations tended to be taken out on their companion animals for which keepers were grateful.

Conclusions

Hand-rearing of Eastern black and Southern white rhino calves does not vary significantly between the two species. The same formula can be used to successfully rear both species. While raised under differing circumstances, it does appear important to provide companion animals for the calves if possible. This seems to significantly reduce the dependence of the calves on their human caretakers. In addition, a companion helps stimulate the calf to exercise and keep things moving through their systems. In having the opportunity over the course of four years to hand-rear four rhino calves, the mammal and veterinary staffs of the San Diego Wild Animal Park have been able to expand their knowledge of these animals. This opportunity has also allowed for the refining of techniques for hand-rearing, including formula composition and feeding protocols, medical problems encountered, and socialization of these calves. A great deal of knowledge regarding growth rates has been gained. Even though much has been learned regarding the care of these animals there is still much to be learned in the future. It is best to leave the calves with their dams but if that becomes impossible the knowledge gained from these calves and others reared elsewhere will only help in the survivability of future calves.

Acknowledgements

Raising four rhino calves takes a tremendous amount of time, energy and dedication and is truly a team effort. The authors wish to give many thanks to the mammal staff of the Wild Animal Park, especially the Animal Care Center. Their input on this paper and their time and effort in rearing these calves is greatly appreciated.

Products Used

Vi-sorbin^R: Vitamin-Iron Preparation with Sorbitol
Distributed by Animal Health
Exton, PA 19341, USA
Div. of Pfizer, Inc.
New York, NY 10017

Lactose (Edible grade)
AMPC, Inc.
2325 North Loop Dr.
Ames, IA 50010

Equi-Aid^R
Natural Psyllium Fiber
Equi-Aid Products, Inc.
Phoenix, AZ 85027

Dextrose
D-(+)-Glucose
(Dextrose; corn sugar)
Sigma Chemical Co.
P.O. Box 14508
St. Louis, MO 63178
314-771-5750

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