

Animals can sometimes be encouraged to consume less palatable forages if hays are soaked in water or sprinkled with molasses. Applesauce had proved to be helpful in administering unpalatable medications and/or supplements.

#### FEEDING LOCATION

As with all zoo species, feed should be offered on a concrete pad or in live-stock troughs or bins. Sand impaction has previously been documented in rhinos (Nouvel & Pasquier, 1946); therefore, feeding directly on the ground is not recommended. To reduce competition for food, individual feeding stations or adequate space at communal feeders is recommended.

#### SUPPLEMENTS

Dietary supplements should be unnecessary in properly formulated rations. A possible vitamin-E deficiency has been suggested but not confirmed in zoo rhinos; current recommendations based on natural browse composition suggest that diets should contain 150 to 200 IU vitamin E/kg dry matter. Salt blocks and water should be available at all times. If grown in an area prone to soil selenium (Se) deficiency, forage should be tested routinely for determination of Se content in order to provide data needed for balancing rations.

#### PROBLEMATIC DIETS

High-quality alfalfa as an exclusive forage is unnecessary and may lead to mineral imbalances, colic and diarrhea. The consumption of fresh red maple browse has been associated with hemolytic anemia in horses and should therefore be avoided. Feeding cabbage, kale and onion to rhinos should also be avoided.

#### BROWSE

Particularly for the browsing rhino species, the addition of fresh and/or frozen browse may be essential to dietary health. Browse may contribute required nutrients that have not yet been quantified and may also be of benefit to dilute a captive diet that is too digestible. Table 22 lists North American browse species that have been successfully fed to rhinos.

## HAND-BEARING



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A limited number of rhino calves have been and are currently being raised using various formulas. Reports and published information must be carefully scrutinized for measures of success and methodology in milk-sample analysis. The following information uses the ungulate hand-rearing chapter in the AZA Infant Diet Notebook as a base for general feeding guidelines and formula selection (Reiter et al., 1994). This recommendation is to be used as a guideline for standardization of a hand-rearing diet. For current information, contact the author.

**TABLE 22. North American browse species acceptable for rhinos (partial listing)**

Crabapple	<i>Malus</i> sp.	Weeping Willow	<i>Salix babylonica</i>
Silver Maple	<i>Acer saccharinum</i>	Black Willow	<i>Salix nigra</i>
Sugar Maple	<i>Acer saccharum</i>	Fraxinus	<i>Liquidambar</i> sp.
Alder	<i>Alnus</i> sp.	Grape	<i>Vitis vinifera</i>
Hackberry	<i>Celtis occidentalis</i>	Banana	<i>Musa acuminata</i>
American Beech	<i>Fagus grandifolia</i>	Torch Ginger	<i>Phacoamerica</i> sp.
Weeping Fig	<i>Ficus benjamina</i>	Sweetgum	<i>Liquidambar styraciflua</i>
Forsythia	<i>Forsythia</i> sp.	Prickly Pear	<i>Opuntia leptocaulis</i>
Kentucky Coffee Tree	<i>Gymnocladus dioica</i>	Huisache	<i>Acacia farnesiana</i>
Hibiscus	<i>Hibiscus rosa</i>	Brazil	<i>Condalia obovata</i>
White Mulberry	<i>Morus alba</i>	Catclaw	<i>Acacia roemeriana</i>
Golden Bamboo	<i>Phyllostachys aurea</i>	Mesquite	<i>Prosopis juliflora</i>
White Poplar	<i>Populus alba</i>	Granjeno	<i>Celtis pallida</i>
Black Locust	<i>Robinia pseudoacacia</i>		

**TABLE 23. Compositions of rhino hand-rearing formulas**

Ingredients	Parts by Volume	
	Formula 1	Formula 2
Water	32	9
Skim milk	32	9
Karo Syrup	1	1



While not common, hand-rearing of rhinos has been accomplished by North American institutions. (Photo: Knoxville Zoological Gardens)

#### MILK COMPOSITION AND FORMULA SELECTION

Based on available data, rhinoceros milk is more dilute than milks of other ungulate species. It is low in solids, low in protein, very low in fat and high in sugar compared with milk of equids, bovids and cervids (Ofstedal, 1984). Formula selected (Table 23) should mimic mother's milk in composition as much as possible (Table 24). Two formulas are presented: Formula 1 has been used to raise a calf to 1 year of age; Formula 2 more closely mimics mother's milk.

Though rhinoceros' milk is different from cow's milk, the latter may still be appropriate for hand-rearing rhinos if used in combination with other ingredients. Cow's milk is low in iron; consequently, an iron source such as Fer-in-sol should be added to the formula at two drops per 100 g of formula. In addition, infant vitamins, such as Major Multi-Vita Drops, should also be added to the formula at two drops per 100 g of formula. Some infant vitamins, such as Mead Poly-vi-sol with Iron, contain added iron. The animal may also benefit from the addition of Lactaid at one drop per 100 g of formula. Lactaid aids in carbohydrate digestion and helps prevent possible gastrointestinal tract distress.

If the neonate is less than 24 hr old, colostrum diluted 50% with water or an electrolyte solution for ungulates, such as Replenish, should be administered for the first 24 hr. Though species specific colostrum is preferred, cow colostrum may be used. Products such as Colostrix may also be used (Table 25).

To avoid gastrointestinal distress, a diluted formula should be offered beginning on day 2. The formula can be gradually increased to full concentration depending on the animal's health, including weight gain and stool condition.

#### FEEDING REGIMEN

Quantity fed should range from 10 to 13% of body weight. Animals should be fed every 2 hr. Because infants suckle during daylight hours, feeding should be equally spaced in a 12-hr period not to exceed 3% of body weight at any one feeding. It is recommended that feeding begin with 10% of body weight split equally into 12 feeds 1 hr apart during daylight hours. The quantity of formula fed should be adjusted daily based on the animal's weight. Animals should be weighed at the same time each day. Fresh water should be available at all times.

If diarrhea occurs, the quantity of formula fed should be decreased or the formula diluted until stool condition returns to normal. If diarrhea is persistent, an electrolyte solution can be used to dilute the formula, replacing some or all of the water. In addition, the number of feedings can be increased to lessen the quantity fed at any one time.

Formula can be prepared ahead of time and warmed as needed. Water should be boiled to decrease possible contamination due to pathogens, then refrigerated before being added to the formula. The formula should be refrigerated and used within 72 hr. Prior to feeding, the formula should be warmed to the animal's body temperature. Calf nipples work well with large species. Bottles should be boiled before use. Diluted bleach may be used as a disinfectant. Formula left over from each feed should be discarded.

**TABLE 24. Nutrient compositions of rhino milk (Gregory et al., 1965) and recommended formulas (as-fed basis)**

Formula	Percent as Fed			
	Solids	Protein	Fat	Sugar
Rhino milk	8.8	1.4	0.2	6.6
Formula 1	10.3	3.3	0.3	5.9
Formula 2	8.3	1.7	0.2	6.6

**TABLE 25. Products used in hand-rearing diets**

Product	Manufacturer/Distributor
Colostrix	Protein Technology, Inc. Minneapolis, MN 95403 1-800-645-3839
Replenish	Fermenta Animal Health Co. Distributor Kansas City, MO 64153
Fer-in-sol Poly-vi-sol with Iron	Mead Johnson Nutritionals Bristol-Meyer Co. Evansville, IN 47721
Major Multi-Vita Drops	Major Pharmaceutical Corp. Distributor Chicago, IL 60612
Lactaid	Lactaid, Inc. P.O. Box 111 Pleasantville, NJ 08232

## WEANING

Weaning may begin at as early as 6 months and should be completed in 1 year. Weaning is a slow process involving carefully monitoring body weight and solid food consumption. Animals should have access to solid food at all times. A nutritionally complete pelleted diet such as Calf Manna, horse feeds or high fiber ungulate pellets, in addition to alfalfa hay, is appropriate. Formula may be decreased by gradually eliminating the number of feeds or decreasing the amount offered per feed and gradually decreasing the number of feeds.

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