Sumatran Rhino Nutrition

Based on even fewer field studies of native food composition (Dierenfeld et al., 1994; Lee et al., 1993, Van Strien, 1985), and extremely limited laboratory data, the same general feeding principles and recommendations (see Summary, above) appear to hold true for the "other" browsing rhinoceros species, the Sumatran (*Dicerorhinus sumatrensis*).

Ten browses consumed by Sumatran rhinos in Malaysia contained less cellulose (14 to 23% of DM), but even higher lignin levels (8 to 24%) than black rhino browses, suggesting that south-east Asian forages may be less digestible than African browses. Total cell wall (NDF) averaged 50%; ADF, 27%). Crude protein levels in Malaysian (n=10) and Indonesian (n=12) browses identical to ranges recorded in African forages (6-24%), with average available protein content about 9% of dry matter. No work has been conducted on soluble sugars, or lipid content of Sumatran rhino diets.

Sodium appears limiting in native browses, but can and is readily obtained through natural salt licks utilized by Sumatran rhinos. Phosphorus, particularly in relation to calcium content, also appears limiting in native rhino browses; overconsumption of high-Ca forages (including alfalfa) may precipitate metabolic imbalances of these nutrients. More work regarding mineral status of browsing rhinos is required.

Although much emphasis has been placed on vitamin E nutrition of black rhinos over the past decade, almost no data exist on this nutrient in Sumatran rhinos. Tissue (liver, heart, skeletal muscle, and adipose) concentrations have been measured in 3 animals; results suggest metabolic similaries with black rhinos in hepatic or adipose storage of this nutrient, but uniqueness in muscle tissue metabolism. In general, domestic horses do not appear to provide useful comparative indicators for tissue vitamin E status in any of the rhinoceros species.

After prolonged diet refinement to improve diet palatability and fecal consistency, feeding trials at Bronx and Cincinnati Zoos resulted in a daily diet comprising mixed hay (intake approximately 10 kg), 3.2 kg of a high-lignin browser pellet, and 3 to 4 temperate browses, to most closely duplicate natural forage composition for maintenance of adult Sumatrans. Nonetheless, diets appear not entirely adequate, and health problems which may be linked to nutrition continue to affect browsing rhino populations in zoos. Clearly immediate attention to identified research priorities for understanding nutritional biochemistry and physiology of these species is critical, before they are lost to us forever.

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Veterinary Medicine In North American Rhinoceros Programs

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Veterinary medicine has been an integral part of the management of captive rhinoceros populations. In North America, veterinary contributions have been formalized by the inclusion of Veterinary Advisors to each rhinoceros Species Survival Plan (see addendum below). For white rhinoceroses (*Ceratotherium simum*), reported diseases have not been remarkable or unusual, but for black (*Diceros bicornis*) and Sumatran (*Didermocerus sumatrensis*) rhinoceroses, veterinary medical problems have been a limiting factor in the maintenance of captive populations.

Descriptions of the general diseases of rhinoceroses are available from several sources.[1,3,5,11,12,13] Recently, two bibliographies for rhinoceroses have been published.[6,14] Several diseases of large animals, such as tuberculosis, can presumably affect all rhinoceros species (in rhinoceroses, infection with *Mycobacterium bovis* has been most frequently reported). Although the data are inadequate to make definitive testing recommendations, it is of interest to note that several infected animals have had positive reactions with intradermal PPD bovis in the eyelid. Any reactors should have mycobacterial cultures performed on tracheal and/or gastric lavage samples for confirmation.

Leptospiral infection has been indicated in some of the black rhinoceroses undergoing hemolysis,[2] and has also been identified in an aborted fetus from a greater Asian one-horned rhinoceros (*Rhinoceros unicornis*). In the black rhinoceros, vaccination with a leptospiral bacterin containing five serovars has been recommended (Leptoferm-5, Norden Lab. Inc., Lincoln, Nebraska, USA).[2] Excessive build-up of oral plaque has been noted in several captive black rhinoceros, and a thorough oral examination of all anesthetized rhinoceroses is warranted.

Black Rhinoceroses

Diseases of black rhinoceroses are characterized by several syndromes of unusual nature and uncertain etiology or pathogenesis. These include hemolytic anemia, mucocutaneous ulcerative disease, encephalomalacia, hemosiderosis and fungal pneumonia. Hemolytic anemia has been identified as the leading cause of death

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in captive black rhinoceros.[7] Since leptospiral infection did not account for all of the hemolytic cases,[2] a series of investigations was initiated to determine if properties of the black rhinoceros red blood cell (RBC) could account for the hemolysis. The most significant and promising findings to date have resulted from studies of RBC metabolism.[10] In light of the metabolic findings, exposure to oxidative agents and many drug compounds should be avoided (e.g., bleaches, drugs like isoniazid). In several cases, a marked hypophosphatemia has developed with the hemolysis and may, in itself, contribute to red cell destruction. Additionally, plants and compounds, such as red maple or members of the Brassica family, that cause hemolytic anemia in domestic animals should also be carefully avoided in rhinoceroses.

A syndrome mucocutaneous ulcers has also had a major impact on captive black rhinoceroses (45+ cases identified).[9] The first signs are often small vesicles or ulcers over points of wear, that may progress to cover large areas of the body. There may be spontaneous regression, however, in some cases, thesyndrome may lead to death. At the present time, the etiology remains unknown. Infection with the skin parasite *Stephanofilaria dinniki* has not been seen in captive animals, nor have any of the North American cases been associated with viral infections. A marked response to corticosteroid therapy has been noted in some cases; however, this also appears to predispose individual animals to fungal pneumonia. Although many of the cases of fungal pneumonia (primarily *Aspergillus* sp.) have been on immunosuppressive therapy, nearly 50% have occurred spontaneously.

Encephalomalacia, primarily affecting white matter, has been noted in three calves and one 2-year-old black rhinoceros.[8] The neurological signs have been variable, so histological examination of brain tissues is warranted in all rhinoceros deaths. Additionally, accumulation of iron in the tissues of black rhinoceros has been shown to be correlated with length of time in captivity.[4] Lastly, exposure to creosote has been associated with a syndrome of liver failure, and so should be carefully avoided in all species of rhinoceroses.

Sumatran Rhinoceroses

Although the number of Sumatran rhinoceroses held in western captivity has been limited, their medical histories have been notable. Causes of death have included intestinal torsions, a uterine mass (in Great Britain), and histology results are pending on two additional deaths. There are indications that another captive female may also have uterine abnormalities.

Greater Asian One-Horned Rhinoceros

Diseases of greater Asian one-horned rhinoceroses have been notable for an apparently increased incidence of abortion (note above that one case was associated with leptospiral infection), foot problems including chronic infections, and uterine leiomyomas.

White Rhinoceros

In contrast to the diseases of the other rhinoceros species, those of the white rhinoceroses (*Ceratotherium simum*) appear to be more similar to those of large domestic animals and of an apparently lower incidence.

Identification of disease in individual rhinoceroses is the first step in the process that allows SSP Veterinary Advisors to identify patterns of disease and syndromes. To forward information, or to ask questions, you may wish to contact one of the North American SSP Advisors listed below:

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