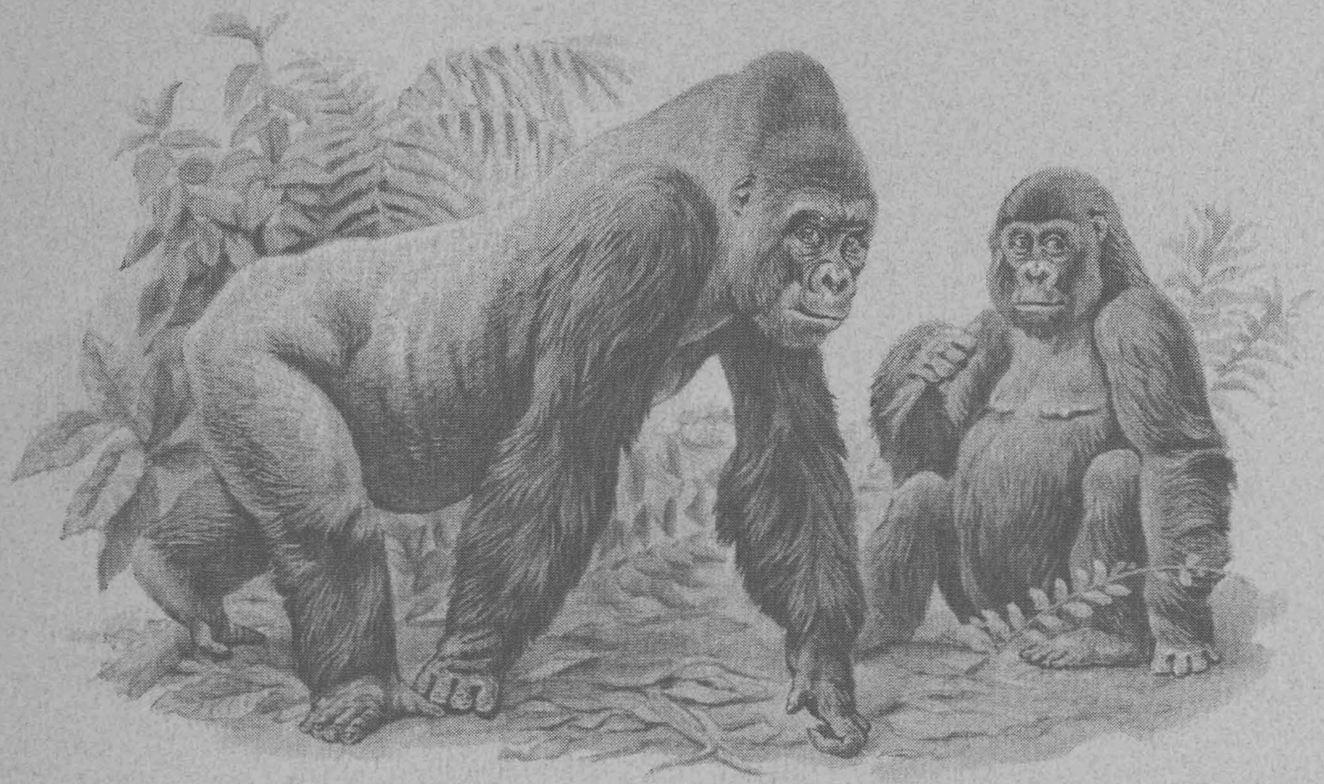
NC STATE UNIVERSITY

COLLEGE OF VETERINARY MEDICINE



First Annual Crissey Zoological Nutrition Symposium

Raleigh, North Carolina

December 12 & 13, 2003

First Annual Crissey Zoological Nutrition Symposium
Raleigh, North Carolina
December 12 and 13, 2003

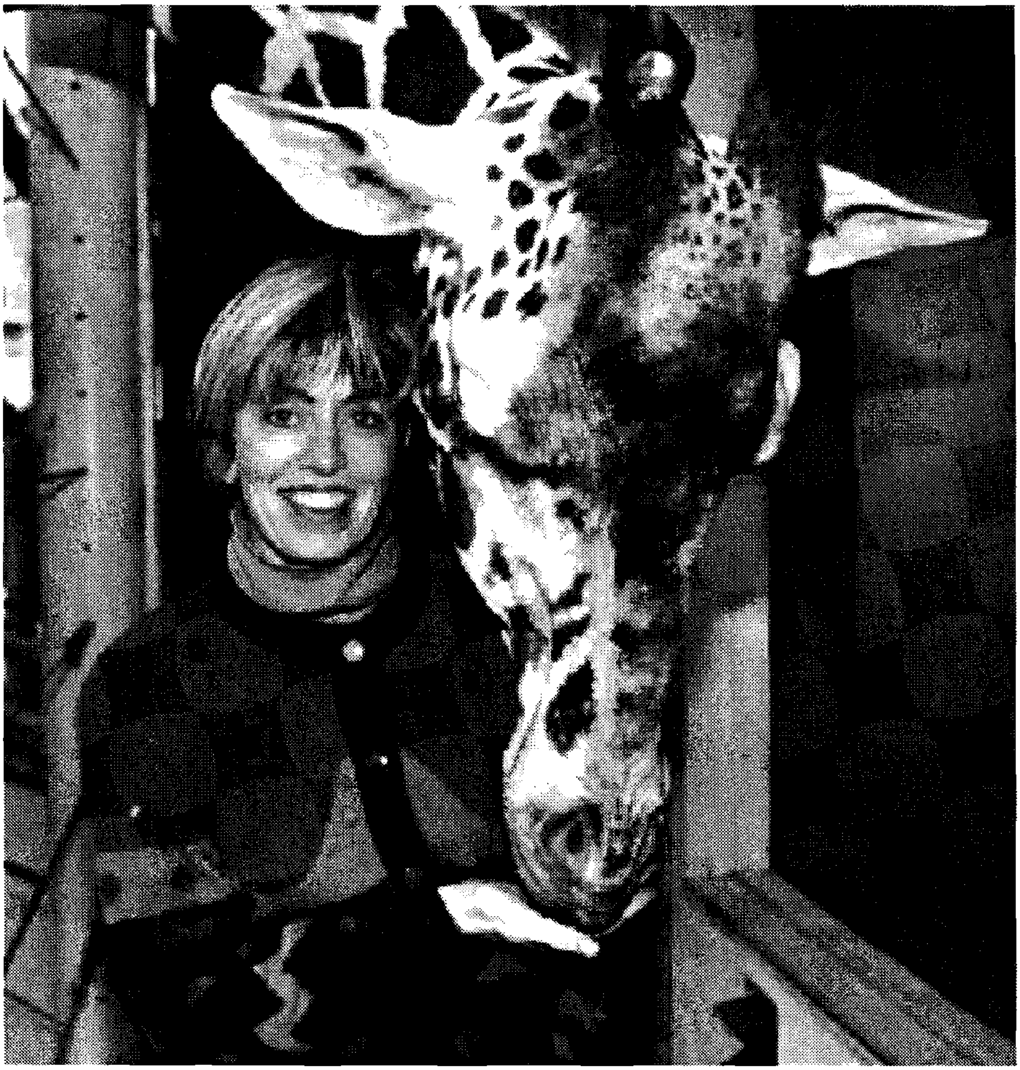
Susan D. Crissey, Ph.D.
December 12, 1951- November 23, 2002

Sue Crissey earned her B.S. and M.S. degrees in human nutrition from Michigan State University and spent four years with the FDA before accepting a scholarship from the University of Maryland to pursue a Ph.D. in animal nutrition. She completed a post-doctoral fellowship at the Smithsonian Institution's Conservation Research Center in Front Royal, Virginia and began field work studying howler monkeys in Venezuela. From there she joined the staff of the Brookfield Zoo in Chicago where she developed and led their nutrition programs.

Sue continued as Director of Nutrition for Brookfield Zoo until her death. It was much to North Carolina State University's advantage when Sue moved to Burgaw, North Carolina to be with her husband Chris Smith. She accepted an appointment as adjunct assistant professor in the Department of Clinical Sciences and taught many students the basics of zoological nutrition. Sue was an energetic and engaging lecturer who could draw on her work with nutritional diseases in species that included rhinoceros, wild felids, howler monkeys, golden marmosets, bottlenosed dolphins, micronesian kingfishers, and many more, to illustrate her talks and discussions. Sue published over 100 scientific papers including several seminal topical reviews. In 2002 she was awarded the Duane E. Ullrey Achievement Award by the American Association of Zoo Veterinarians for her distinguished work.

Sue loved her North Carolina farm, and maintained a significant menagerie of zoo retirees and castaways there, commuting from her home in Burgaw, to Chicago to manage her zoo duties, and traveling to Raleigh at the drop of a hat to teach. Sue was a meticulous scientist whose enthusiastic joys of teaching and insistence on "good science" have become part of those who were lucky enough to be around her for any length of time. Future generations of zoological nutritionists are richer for her having been, but poorer for not knowing her.

"*I don't know that I was a great teacher, but in almost everything I did, I tried to encourage others to look for opportunities to be helpful to people and to appreciate our natural world.*" Sue Crissey, 2002



Susan D. Crissey

NUTRIENT CONSUMPTION AND IRON STATUS IN SEVEN BLACK RHINOCEROS (*DICEROS BICORNIS*) IN THREE INSTITUTIONS

Ann M. Ward, M.S*[1] and Kerri Slifka, M.S.[2]
[1]Fort Worth Zoo, Fort Worth, TX 76110, USA, award@fortworthzoo.org
[2]Chicago Zoological Society, Daniel F. and Ada L., Rice Conservation Biology and Research Center, Brookfield Zoo, Brookfield, IL 60513, USA, keslifka@brookfieldzoo.org

Hemosiderosis occurs in captive black rhinoceros but not in free ranging animals.[1,3] Though plants consumed by free-ranging black rhinoceros have been identified, their contribution to the overall diet has not been quantified. Consequently the level of iron consumed by free-ranging animals, as well as other minerals and iron binding polyphenolics, is not known. Diets offered captive black rhinoceros have been quantified.[4] However, nutrient levels consumed often differ from levels offered. Nutrient consumption data were collected for a 6 month period for black rhinoceros at the Brookfield Zoo, Fort Worth Zoo, and Fossil Rim Wildlife Center. Serum iron parameters were measured prior to the 6 month period and following.

The ratio of diet ingredients set at each institution was reflective of the diet normally consumed by those animals (Table 1). For the 6 month period diets were manipulated to ensure the set ratios were consumed. Diets were analyzed for crude protein, neutral detergent fiber, acid detergent fiber, fat, calcium, phosphorus, magnesium, potassium, sodium, iron, zinc, copper, manganese, total iron binding polyphenolics (TIBP), and iron binding tannins (IBT) by standard procedures. Blood was collected prior to and post the 6 month period. Ferritin, transferrin saturation, total iron binding capacity (TIBC), and iron were among parameters determined.

All nutrient levels met or exceeded known nutrient requirements for horses,[2] suggested as a guide for black rhinoceros. Crude protein, fiber fractions, calcium, magnesium, potassium, and sodium levels appeared similar while concentrations of fat, iron, zinc, copper and managanese varied among institutions (Table 2). No TIBP or IBT were detected in any diet. Comparing iron status parameters pre and post the 6 month period, serum ferritin values increased in all animals except one. It is possible that lack of consistency in the time of day samples were taken pre and post could have been a factor. Transferrin saturation and serum iron decreased or changed little for all animals while TIBC varied (Table 3). Because iron parameters vary based on sex and age, it was not possible to combine all animals at each institution for comparison. In general, the institution with the most animals with low serum ferritin values was also the institution with the lowest iron diet (Fossil Rim). Serum ferritin values for Brookfield animals ranged from the second lowest to the highest across institutions. Across institutions serum ferritin values were within the range reported for long term captive black rhinoceros, 2,200±2,240 ng/ml, but well above the 133±62 ng/ml reported for free-ranging animals.[3] Transferrin saturations were also within the range reported for captive animals (65±22 %), with two animals from two different institutions similar to free-ranging values, 28±6 %.[3] Serum iron values for most animals exceeded those for free-ranging animals, 101±19 ug/dl.[3]

This work could not have been completed without the significant contribution of Sue Crissey, Ph.D. Sue was a co-investigator on this project, which is part of a grant, "Dietary iron absorption and the role of tannins in Eastern (*Diceros bicornis michaeli*) and Southern black rhinoceros (*Diceros bicornins minor*), a comparison, funded by IRF and SOSRhino.

Literature Cited

1. Kock K, Foggin C, Kock MD, Kock R. 1992. Hemosiderosis in the black rhinoceros (*Diceros bicornis*): a comparison of free-ranging and recently captured with translocated and captive animals. J Zoo Wildl Med 23:230-4.
2. National Researach Council. 1989. Nutrient Requirements of Horses, 5th Revised Edition. Washington, DC: National Academy Press.
3. Paglia DE, Dennis P. 1999. Role of chronic iron overload in multiple disorders of captive black rhinoceros (*Diceros bicornis*). Proc Am Assoc Zoo Vet Ann Conf. P 163-71.
4. Ward AM, Hunt AS. 2001. Summary of mineral and iron binding polyphenolic plant compound levels in diets offered captive black rhinoceros (*Diceros bicornis*) in 3 zoos and 1 ranch in Texas. Proc AZA NAG 4th Conf on Zoo and Wildl Nutr. P.173-86.

Table 1: Ingredient contribution of diets consumed by black rhinoceros at 3 institutions on a dry matter basis.

Ingredient	Brookfield	Fort Worth	Fossil Rim
Pellets	45.8 %	39.0 %	48.8 %
Alfalfa	39.7 %	50.3 %	31.9 %
Grass Hay	7.8 %	8.3 %	18.3 %
Produce	6.5 %	2.4 %	0.8 %
Supplements	0.2 %[a]	0 %	0.2 %[b]

[a]Trace mineral salt.
[b]Bonemeal and Missing Link.

Table 2: Nutrient content of diets consumed by black rhinoceros at 3 institutions on a dry matter basis.

Nutrient	Horse Rec.[2]	Brookfield	Fort Worth	Fossil Rim	Mean ± SD
Crude Protein, %	8-15	16.9	15.7	16.5	16.4±0.6
Neutral Detergent Fiber, %	-	37.7	36.3	36.9	37.0±0.7
Acid Detergent Fiber, %	-	23.0	22.3	20.7	22.0±1.2
Crude Fat, %	-	1.6	1.6	2.2	1.8±0.4
Calcium, %	0.3-0.6	0.8	1.0	1.0	1.0±0.1
Phosphorus, %	0.2-0.3	0.6	0.4	0.4	0.5±0.1
Magnesium, %	0.1	0.3	0.3	0.3	0.3±0.03
Potassium, %	0.3-0.4	2.1	2.1	1.9	2.1±-0.1
Sodium, %	0.1	0.3	0.3	0.3	0.3±0.01
Iron, ppm	50	227.4	414.0	200.0	280.5±116.4
Zinc, ppm	40	207.7	107.4	73.9	129.5±69.7
Copper, ppm	10	38.3	44.3	12.7	31.7±16.8
Manganese, ppm	40	171.0	88.7	88.2	116.0±47.7

Table 3: Iron status parameters in black rhinoceros at 3 institutions.

	Brookfield						Fort Worth				Fossil Rim		
	Kabisa		Naivasha		Nakili		Mtoto		Muponi		GotaGota		Kusamona
	Prior	Post	Prior	Post	Prior	Post	Prior	Post	Prior	Post	Prior	Post	Prior
Ferritin[a]	1761	2625	2283	2394	550	772	2321	2364	777	871	818	614	1444
Transferrin Saturation[b]	83	77	66	47	45	35	93	89	45	40	58	32	68
TIBC	276	287	271	244	344	238	389	319	345	362	313	329	329
Iron[c]	230	220	178	115	154	119	362	285	154	144	181	104	223
Sex	Male		Female		Male		Female		Female		Male		Male
Age	18 yr		21 yr		13 yr		14 yr		4 yr		18 yr		7 yr
Captive or Wild Born	Captive		Captive		Captive		Captive		Captive		Wild		Captive

[a]Ferritin units = ng/ml.
[b]Transferrin saturation = %.
[c]Iron units = ug/dl.