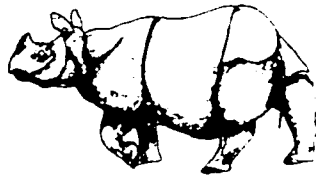


AZA SSP MASTERPLAN

INDIAN/NEPALESE RHINO
(Rhinoceros unicornis)

1994 Edition



Species Coordinator: Mike Dee

AZA SPMAG Advisor: Tom Foose

AZA Conservation Center: Kevin Willis

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BACKGROUND OF THE INDIAN/NEPALESE RHINO SSP PROGRAM

The first AZA SSP plan for Indian/Nepalese Rhino was prepared by AZA Conservation Coordinator Tom Foose in 1981. Further refinements were formulated in 1984. The first masterplan developed through the SSP masterplan workshop process was produced in 1989 with Mike Dee as the Species Coordinator and Tom Foose and Randy Rockwell as AZA (then AAZPA) advisors.

Establishment of the SSP program was motivated by the uncertain prospects for this species in the wild. Although the programs and populations in the wild have been one of the few success stories in rhino conservation over the last decade, challenges to the in situ situation are significant and increasing. There are approximately 1900 rhino in the wild: about 1500 in India (mostly Assam) and 400 in Nepal. (Table 1). However, poaching is intense and intensifying. Currently, the average loss to poachers is estimated at a minimum of 5% of the total population per year. Since the annual rate of increase is also about 5%, poaching is now at a level to prevent further increase of the population. Moreover, in some areas (e.g. Manas and Laokhowa poaching has been even more severe reducing the population by 50-75% in Manas and totally annihilating it in Laokhowa. In addition to poaching, habitat degradation also continues. Both of these threats are expected to increase, perhaps rapidly, in the immediate future.

The status of the SSP population and program have changed considerably over this period, improving in some respects, i.e. the demographics but declining in others, i.e. the genetics.

	1981	1989	1994
Animals	11.10 = 22	16.16 = 32	22.20 = 42
Institutions	8	11	15
Founders	10	17	17
F.G.E.	-	7.04	5.354

The objectives for the SSP population in the 1989 SSP Masterplan included:

- Trying to preserve 90% of the genetic diversity from the wild population for 200 years;
- Attaining a total of 20 effective founders
- Achieving an N_e/N ratio of .5.
- Hence acquiring 13 more founders by:
 - recruiting reproduction from non-producing founders;
 - recruiting more offspring from founders with 1 or few offspring;
 - adjusting the founder representation of existing founders;
 - obtain 2 more founders from captivity elsewhere
 - obtain 6-8 more founders from the wild
- Expanding the population to a target size (carrying capacity) of 80 rhino.
- Moving the population from existing to target founder distribution by reproducing animals according to offspring objectives.
- Sustaining an annual population growth rate of 4%.

Progress toward these objectives over the last 5 years has been mixed. The N_e/N ratio is still only about .33. No new founders have been recruited for the captive-born (living descendant) population although 4 of the potential founders have actually produced offspring which unfortunately did not survive. To additional rhino have been obtained from the wild and represent potential founders. The number of founder genome equivalents has actually declined. In contrast the population has increased from 32 to 42 rhino (a realized annual rate of increase of 6%).

It should be mentioned that the science of population management has evolved considerably over the last decade and hence the objectives and criteria for the Indian/Nepalese Rhino SSP have been adjusted accordingly. One major change since the 1989 masterplan is the emergence of mean kinships (Mk) as the primary tool for genetic management in contrast to the crude founder representation tabulations and inbreeding coefficients in 1981 and Founder Importance Coefficients (FIC) in 1989. The current protocol for population management is summarized in the AZA SSP central dogma (Box 1)

The first draft of this current masterplan for the Indian/Nepalese Rhino SSP has been formulated at a workshop conducted at the Los Angeles Zoo 8-9 April 1994. Participants included:

- Mike Dee - Los Angeles Zoo - Species Coordinator
- John Carnio - Metro Toronto Zoo
- Jim Doherty - New York Zoological Park
- Mike Fouraker - Fort Worth Zoo
- Randy Reiches - Zoological Society of San Diego
- Curby Simmerson - Zoological Society of San Diego
- Lewis Greene - New York Zoological Society
- Tom Foose - International Rhino Foundation/The Wilds - AZA SPMAG Advisor
- Kevin Willis - AZA Conservation Center
- Bob Wiese - AZA Conservation Center

STATUS OF THE INDIAN/NEPALESE RHINO SSP POPULATION

Demographically, the SSP population is healthy, both relative to other rhino populations, and in absolute terms.

- There are a total of 42 (22.20) rhino in 15 institutions.
- 71% of these rhino are captive born.
- Over the last 10 years the average annual rate of change (growth) has been at least 4% and more recently as much as 6%. This rate of growth approximates what has occurred in the wild populations. (Appendix 1)
- It is the case however that much of the reproduction to date has been by a limited number of individuals and institutions. (Table 3) Nevertheless, the prospects are good for expansion of the breeding population in the immediate future.
- The age structure is also healthy with a majority of rhino in prime reproductive years and a good foundation of young animals.

Genetically, the SSP population is not in acceptable condition and is less healthy than other SSP rhino populations. (Table 4)

- The captive-born (living descendant) population currently has only 90.5 % gene diversity, i.e. the level is just barely greater than the amount to be retained for the next 90 years. This relatively low level is due to the domination of breeding by a limited number of individuals.
- There are only 5.35 Founder Genome Equivalents (roughly effective number of founders) out of a potential 19.97 actually in the captive population.) The discrepancy is due to the lack of reproduction by a number of potential founders (Table 5), actual loss of alleles from some founders because they didn't reproduce enough, and unevenness in the relative representation of founders in the captive-born population.
- However, the potential exists to significantly improve the genetic situation in this species in the near future. (Appendix 3)

There are a number of particular points or problems of concern with the current population.

- Older wild-caught animals that have not reproduced (49, 50, 67)
- Wild caught females at Fort Worth (191) and San Francisco (137) with males (190, 136) probably too young to reproduce.
- A number of pairings that are not beneficial to genetic objectives and management of the population:
 - Washington: Male (101) with relatively high M_k with two wild-caught females (138, 139)
 - Los Angeles: Male (35) with relatively low M_k with females (45, 89) with relatively high M_k .

GOALS & OBJECTIVES OF THE AZA INDIAN/NEPALESE RHINO SSP

Purpose:

The primary purpose of this SSP program is to assist with conservation of the species by providing a long-term self-sustaining captive population for (1) a demographic and genetic reservoir for support of wild populations as the need and opportunity occurs in the future and (2) educational programs that enhance conservation efforts for the species.

The program will also secondarily support conservation of the species by using the captive population for applied research and to attract funds for *in situ* conservation efforts.

Objectives:

- (1) *Attempt to preserve in the SSP population 90% of the gene diversity of the wild population for a period of 100 years.*

The program has already been in progress for 10 years. Hence the 100 year point in this program will occur in 2085.

- (2) *Cooperate with other regional captive breeding programs for this species, especially with those that develop compatible objectives.*

Such cooperation could preserve even higher levels of gene diversity for longer periods of time (e.g. maintaining 90% of gene diversity for 10 rhino generations 150-175 years). Toward this end, it is recommended the SSP Species Coordinator and SPMAG Advisor attend the European Rhino TAG and EEP Meetings in the Netherlands June 1994.

- (3) *Manage the existing population to maximize gene diversity by preferentially breeding individuals with low and comparable mean kinships (M_{fs}).*
- (4) *Adopt a target population of 90 rhino to achieve the genetic goals.*

This target represents an increase from the 80 animals recommended in the 1989 SSP Masterplan and is the target size recommended for North America in the 1992 Rhino Global Captive Action Plan (GCAP). (Table 6).

The ability of this population size to achieve the genetic objectives is based on the assumptions:

- (A) The equivalent of 11 additional founders (as measured by Founder Genome Equivalent) can be recruited to the population. One way this can be achieved is by adjusting the relative representation of the founder lineages represented in the current captive born (living descendant) population and by inducing the 9 wild-caught individuals in the population that have not yet reproduced to breed with the objective of ultimately producing at least 4 offspring from each. There will also be an attempt to recruit 1-2 additional founders by providing females from the SSP population in exchange for males from Indian zoos which currently have an excess of males.
- (B) The N_e/N ratio will be increased rapidly by the improved management from its current level of approximately .3 to at least .5.
- (C) The improved management will rapidly increase the amount of gene diversity actually captured in the living descendant population to 97%.

A summary of these assumptions and the calculations deriving 90 as an adequate target size to achieve the genetic objectives is provided in Appendix 4.

- (5) *Recruit additional qualified facilities to maintain this species in order to accommodate the proposed doubling of the current population to its target size.*

An overview of current, recommended, and possible (known or recommended) ultimate number of rhino of various species is illustrated in Table 2.

- (6) *Improve the husbandry of this species to enhance the well-being and the breeding of this species.*
- (A) Develop minimum enclosure standards and vigorously encourage those institutions maintaining the species to comply. A particular problem is enclosures that are too small or unsafe to accommodate breeding.
 - (B) Ameliorate problems with introduction of males and females for breeding. Prepare inexperienced facilities for the aggressive interactions that can typically occur during courtship. Toward this end, develop a video of such interactions and introductions starting with footage that is already available (e.g. San Diego)
 - (C) Conduct aggressive evaluation and intervention for the number of genetically important adult rhino that have failed to reproduce successfully, including females 50 (Miami) and 67 (New York) and males 49 (Miami) and 53 (New York).

SUMMARY INDIAN/NEPALESE RHINO SSP RECOMMENDATIONS

A total of 12 breedings are recommended (Table 7).

To achieve management objectives, relocations of up to 20 individuals are recommended (Table 8).

A total of 3 individuals are designated as surplus to the SSP program. Two of these rhino are recommended for relocation other regional captive breeding programs where they will not be genetically surplus. The third individual will be retired.

Table 1

WILD POPULATION ESTIMATES OF THE GREAT ONE-HORNED RHINOCEROS

Country	Location	Number of Rhino	Habitat Availability km ²		Protection Status	Potential Carrying Capacity
			Presently	Potentially		
INDIA	Manas	60+	391	391	National Park; World Heritage Site	> 100
	Dudhwa	11	490	490	National Park	> 100
	Kaziranga	1164 ± 134	430	490	National Park	1200+
	Laokhowa	0	70	70	Wildlife Sanctuary	50+
	Orang	90+	76	76	Wildlife Sanctuary	> 100
	Pobitora	56	18	18	Wildlife Sanctuary	60+
	Pockets-Assam	25	508	508	Insecure	100+
	Jaldapara	33+	216	225	Wildlife Sanctuary	80+
	Gorumara	13	8.6	66	Wildlife Sanctuary	20+
	Royal Bardia	40+	968	968	National Park	300+
NEPAL	Royal Chitwan	375-400	932	1,200	National Park	500
	Lal Sohanra	2	?	?	National Park	?
TOTAL		1870-1895 ± 134				2600+
		~ 1900				

Table 2
CURRENT AND TARGET NUMBERS OF RHINO IN AZA SSP RHINO INSTITUTIONS

INSTITUTION	CURRENT NUMBER					RECOMMENDED NUMBER					ULTIMATE CAPACITY (within 7 yrs)				
	BLACK	WHITE	INDIAN	SUMTRN		BLACK	WHITE	INDIAN	SUMTRN		BLACK	WHITE	INDIAN	SUMTRN	
ATLANTA	1.1										2.1				
ALBUQUERQUE		1.1				1.1					1.1			1.2	
ASHEBORO		2.2										2.2			
BALTIMORE		1.1				1.1					1.1				
BATON ROUGE		1.2						1.1					1.1		
BIRMINGHAM		1.2						1.1					1.1		
BROWNSVILLE		3.2				2.2					2.2				
BUFFALO			1.0					1.1					1.2		
CALGARY						1.2					1.2				
CHICAGO - BROOKFIELD	3.2					2.2					2.2				
CHICAGO - LINCOLN PARK	1.2					1.2					1.2				
CINCINNATI	2.1		1.0		1.1	2.2		1.1	1.2		2.2		1.2	1.2	
CLEVELAND		1.1				1.1					1.1				
COLORADO SPRINGS	2.1										2.2				
COLUMBIA - RIVERBANKS	1.1										1.1				
COLUMBUS	2.1					2.2					2.2				
CUMBERLAND - THE WILDS		3.6				3.12*		1.1			3.12**		2.4		
DALLAS	1.3					1.3					2.3				
DENVER	3.2										2.2				
DETROIT	1.1										1.2				
EL COYOTE RANCH - BASS	1.4					3.7					3.7				
FORT WORTH	1.1	1.1	1.1			1.2	2.4	1.1			1.2	2.4	1.1		
FRESNO		0.1													
GARDEN CITY	1.0					1.1					1.1				
GLEN ROSE - FOSSIL RIM	1.1	3.4				2.4	5.5				2.4	5.5			
HONOLULU	2.0	1.0						1.1					1.1		
HOUSTON		1.2						1.1					1.1		
JACKSON		1.1						1.1					1.1		
JACKSONVILLE		1.1					2.3				2.3				
KNOXVILLE		2.6					2.6					2.5			
LACOMA RANCH - BENSTEN	1.5					1.4					1.4				
LANSING - POTTER PARK	1.0					1.1					1.1				
LOS ANGELES	1.2		1.2		0.1	1.2		2.2	1.1		1.2		2.2	1.2	

Table 2 (con't)
CURRENT AND TARGET NUMBERS OF RHINO IN AZA SSP RHINO INSTITUTIONS

INSTITUTION	CURRENT NUMBER				RECOMMENDED NUMBER				ULTIMATE CAPACITY (within 7 yrs)			
	BLACK	WHITE	INDIAN	SUMTRN	BLACK	WHITE	INDIAN	SUMTRN	BLACK	WHITE	INDIAN	SUMTRN
LOUISVILLE		1.2			1.1				1.1			
MADISON		1.1				1.2				1.2		
MEMPHIS		2.1					1.1				1.1	
MIAMI	4.3		2.1		4.3		2.2	2.2	4.4		2.2	2.2
MILWAUKEE	1.1		1.0		2.2				2.2			
MONROE		1.1										
NEW ORLEANS		1.1			1.1				1.1		3.3	3.3
NEW YORK			2.3				2.4	1.1			2.4	1.1
NORFOLK		1.1				2.4				2.4		
OKLAHOMA CITY	1.0		1.1		1.1		1.1		1.1		1.1	
OMAHA		1.1			1.1				1.1			
PHILADELPHIA			1.1				1.1				1.1	
PHOENIX		1.1			1.1				1.1			
PITTSBURGH		1.1			1.1				1.1			
PORTLAND	1.1				1.1				1.1			
ROCKTON - AFRICAN SAF		2.2				2.2						
ST. LOUIS	1.2				2.2				2.2			
SALT LAKE CITY		1.1			1.1				1.1			
SAN ANTONIO	1.2	1.3			1.2	1.2			1.2	1.2		
SAN DIEGO - WAP	2.1	5.12	6.6		4.4	4.12	4.4	2.2	4.4	4.12	4.4	2.2
SAN DIEGO - ZOO	4.2		1.0	1.1	2.4		2.2		2.4			
SAN FRANCISCO	1.1		1.1			1.1	1.2		1.1		1.2	
SANTILLANA - MCALLEN	1.1				2.2				2.2			
TAMPA - BUSCH GARDENS	2.1				2.1				2.2			
TAMPA - LOWERY PARK			1.0				1.1				1.1	1.1
TOLEDO		1.1			1.1				1.1			
TORONTO		2.2	1.2			2.2	1.2			2.2	1.2	
TULSA		1.2					1.1				1.1	
TUCSON		1.1			1.1				1.1			
TYLER - CALDWELL ZOO	2.2				2.2				2.2			
VALLEJO - MARINE WORLD		1.1				1.2				1.2		

Table 2 (con't)
CURRENT AND TARGET NUMBERS OF RHINO IN AZA SSP RHINO INSTITUTIONS

INSTITUTION	CURRENT NUMBER				RECOMMENDED NUMBER				ULTIMATE CAPACITY (within 7 yrs)			
	BLACK	WHITE	INDIAN	SUMTRN	BLACK	WHITE	INDIAN	SUMTRN	BLACK	WHITE	INDIAN	SUMTRN
WACO - CNTRL TX ZOO		1.1				1.2						
WASHINGTON DC			1.2				1.2					1.2
WICHITA - SEDGEWICK	2.1				1.1				1.1			
WINSTON - WILDLIFE SAF		2.1				2.5				2.5		
YULEE - WHITE OAK	0.1	2.3			3.6	4.12*		1.1	3.6	4.16**		5.5
SUBTOTAL	48.49	55.74	22.20	2.3	56.74	38.79	29.34	8.9	66.85	37.82	33.42	17.20
POTENTIAL PARTICIPANTS												
GRANBY					1.1				1.1			
LITTLE ROCK							1.1				1.1	
KANSAS CITY					1.1				1.1			
MINNESOTA							1.1				2.2	
MINOT - ROOSEVELT PK					1.1				1.1			
MONTGOMERY					1.1				1.1			
ORLANDO - DISNEY					2.2	2.4	2.2		2.2	2.4	2.2	2.2
RACINE					1.1				1.1			
ROLLING HILLS RANCH						1.2			2.2			
SACRAMENTO					1.1				1.1			
SEATTLE					1.1		1.1		1.1		1.1	
SIOUX FALLS - GRT PLNS					1.1				1.1			
TOTAL	50.47	54.74	22.20	2.3	66.84	41.85	34.39	8.9	78.97	39.86	37.46	19.22
RCP/IGCAP TARGET									170	120***	90	50

* 6 for research
 ** 12 for research
 *** 20 for research

Table 3
**REPRODUCTIVE SUMMARY
 OF INDIAN/NEPALESE RHINO
 IN NORTH AMERICA AZA SSP**

	TOTAL ADULT	BREEDERS	NONBREEDERS	ADDITIONAL BREEDERS NEEDED	TOTAL BREEDERS DESIRED
MALES (>6YRS)					
WILD BORN	4	2	2	2	4
CAPTIVE BORN	10	4	6	4	8
TOTAL	14	6	8	6	12
FEMALES (>4YRS)					
WILD BORN	7	1 (4*)	6 (3*)	6	7
CAPTIVE BORN	10	6 (7*)	4 (3*)	4	10
TOTAL	17	7 (11*)	10 (6*)	10	17

Table 4
DEMOGRAPHIC AND GENETIC OVERVIEW OF AZA SSP RHINO POPULATIONS

RHINO TAXON	NUMBER	BREEDERS	LAMBDA	% LAST QTR LIFE	GENE DIVERSITY	F.G.E.	MEAN M_t	$N_{c,d}/N$ $N_{c,f}/N$
Eastern Black	40.29	13.17	~ 1%	25%	.968	15.7	.0316	.40 .43
Southern Black	10.18	4.8	0	0	.950	9.9	.0503	.38 .46
Southern White	52.72 (Total) 50.69 (Nonsurplus)	17.24	~ 0 to - 1%	25%	.965	14.2	.0351	.20 .33
Northern White	2.2	0.0	0	0	0	0	0	0 0
Indian Rhino	22.20	7.8	~ + 4%	10%	.907	5.4	.0934	.18 .36
Sumatran	2.3	0	0	?	0	0	0	0 0

$N_{c,c}$ = Genetic N_c calculated from genetic data:

$$\text{Gene Diversity Retained} = [1 - 1/(2) (\# \text{ Founders})] [1 - 1/(2) (N_{c,c})]$$

$N_{c,d}$ = Genetic N_c calculated from demographic data:

$$N_c = (4) (M_b) (F_b) / (M_b + F_b)$$

Where M_b = Number of Male Breeders and F_b = Number of Female Breeders

N = Total Current Population Size

Table 5
ADULT INDIAN/NEPALESE RHINO THAT HAVE NOT REPRODUCED
IN THE AZA SSP

Population Mean $M_k = 0.0934$

MALES (> 7 Years)						FEMALES (> 6 Years)					
#	Name	Age	M_k	Location		#	Name	Age	M_k	Location	
49	Mohan	25	0	Miami		45*	Randa	25	.0854	Los Angeles	
53	Vinu	23	.0292	New York		50*	Shanti	25	0	Miami	
87	Assam	16	.0797	Milwaukee		67	Radha	20	0	New York	
101*	Pandu	14	.124	Washington		89	Terai	15	.0839	Los Angeles	
116	Jorhat	11	.124	Lowry-Tampa		131	Ella	8	.0656	New York	
125	Chandra	9	.0167	Oklahoma City		137	Shanti	8	0	San Francisco	
126	Akbar	9	.0714	Miami		138*	Mechi	8	0	Washington	
136	Chhendra	8	0	San Francisco		139*	Kali	8	0	Washington	

* Have produced offspring but none have survived.

Table 6
CURRENT AND TARGET POPULATIONS FOR INDIAN/NEPALESE RHINO WORLDWIDE

	NORTH AMERICA	EUROPE	ASIA			S. AMERICA	WORLD
			INDIA	OTHER			
CURRENT	22.20 = 42	17.16 = 33	26.10 = 36	6.6 = 12	1.0 = 1	72.52 = 124	
TARGET	90	80	50	30	0	250	

Table 7
BREEDINGS RECOMMENDED FOR INDIAN/NEPALESE RHINO

Population Mean $M_k = .0934$

♀	ORIGIN	AGE	M_k	BREEDER	♂	AGE	M_k	BREEDER	ORIGIN	♀ LOCATION	♂ LOCATION	YRS TOGETHER	BREED LOCATION
50	W	24	0	Lost Calf	83	18	.0979	Yes	C	Miami	New York		New York
66	W	20	.0167	Yes	49	25	0	No	W	New York	Miami		New York
131	C	8	.0656	No	53	23	.0292	No	C	New York	New York		New York
137	W	8	0	No	35	28	.0083	Yes	W	San Francisco	Los Angeles		Los Angeles
138	W	8	0	Lost Calf	10	39	.0250	Yes	W	Washington	Philadelphia		Philadelphia
139	W	7	0	Lost Calf	10	39	.0250	Yes	W	Washington	Philadelphia		Philadelphia
79	C	19	.0333	Yes	69	20	.0250	Yes	C	Toronto	Toronto		Toronto
191	W	5	0	No	125	9	.0167	No	C	Fort Worth	Oklahoma City		Ft Wrth or OKC
45	C	24	.0854	Lost Clvs.	106	13	.0500	Yes	C	Los Angeles	SDWAP		SDWAP
89	C	15	.0839	No	35	28	.0083	Yes	W	Los Angeles	Los Angeles		Los Angeles
29	C	31	.0792	Yes	87	16	.0797	No	C	SDWAP	Milwaukee		The Wilds
189	C	2	.0375	No	147	6	.0714	No	C	Toronto	Cincinnati		Cincinnati

* Physical or legal owner objects to Masterplan recommendation

Table 8
RELOCATIONS RECOMMENDED FOR INDIAN/NEPALESE RHINO
Population Mean $M_k = .0934$

CURRENT LOCATION	DESTINATION	#	SEX	AGE	M_k	BREEDER ?	PURPOSE
Fort Worth	Oklahoma City (Temporary)	190	M	5	.0167	No	Permit Older Male to Ft. Wrth.
Oklahoma City	Fort Worth (Temporary)	125	M	9	0	No	Breed with 191
Miami	New York - Bronx	49	M	25	0	No	Breed with 66
Miami	New York- Bronx	50	F	24	0	Unsuccessful	Breed with 83
National	Philadelphia (Now)	138	F	8	0	Unsuccessful	Breed with 10
National	Los Angeles (If 139 doesn't)						Breed with 35
National	Philadelphia (Now)	139	F	7	0	Unsuccessful	Breed with 10
National	Los Angeles (If 138 doesn't)						Breed with 35
Los Angeles	San Diego WAP	45	F	24	.0854	Unsuccessful	Breed with 106
San Francisco	LA (Probably Temporarily)	137	F	8	0	No	Breed with 106 or 35
Toronto	Cincinnati	189	F	2	.0375	No	Breed with 147
San Diego WAP	The Wilds	26	M	32	.1521	Yes	Retire
San Diego WAP	The Wilds	29	F	31	.0792	Yes	Breed with 87
San Diego Zoo	Rolling Hills	146	M	6	.1240	No	Maintenance
San Diego WAP	Rolling Hills	180	M	4	.1240	No	Maintenance
San Diego WAP	Stuttgart	182	F	4	.1148	No	Breeding
San Diego WAP	Rolling Hills	184	M	3	.1057	No	Maintenance
San Diego WAP	San Francisco/Then India	T9002	F	1	.1659	No	Breeding/Exchange for Male
Milwaukee	The Wilds	87	M	16	.0797	No	Breed with 29

Masterplan Report
 INDIAN RHINOCEROS Studbook
 (Rhinoceros unicornis)

LIVING POPULATION AT: METROPOLITAN TORONTO ZOO

TORONTO

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome	Known	F	MK	KV	GU-All	GU-CB	Vx	Live Sibs	Repro Offspr	Founder Representation	
<< Restricted >> [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders]																		
69	M	30 Jan 1974	19	28			1.0000	.0000	.0000	.0250	.0298	.5000	.5000	1.600	0.	1.	0	19=50 30=25
79	F	19 Jul 1975	1				1.0000	.0000	.0333	.0239	.2405	.2405	.2405	0.460	1.	0.	0	11=50 1=50
		27 Apr 1979	11				.0000	.0333	.0239	.2405	.2405			0.	1.	0		
189	F	25 Dec 1991	69				1.0000	.0000	.0375	.0367	.0000	.0000	.0000	1.600	.	.	.	19=25 11=25 1=25 30=12.5
		25 Dec 1991	79				.0000	.0375	.0367	.0000	.0000			.	.	.		

Recommendations: 69 and 79 - Breed

189 - Move to Cincinnati and breed with 147 as soon as old enough.

LIVING POPULATION AT: LOS ANGELES ZOO

LOS ANGELES

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome	Known	F	MK	KV	GU-All	GU-CB	Vx	Live Sibs	Repro Offspr	Founder Representation	
<< Restricted >> [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders] [unks = founders]																		
35	M	8 Mar 1966	WILD	WILD			1.0000	.0000	.0083	.0127	.5000	.5000	.5000	0.720	1.	0.	0	
45	F	5 Oct 1969	18				1.0000	.0000	.0854	.0741	.1375	.1375	.1375	0.340	2.	1.	0	18=50 7=25 5=25
		22 Nov 1974	17				.0000	.0854	.0741	.1375				.	.	.		
89	F	13 Aug 1979	32				1.0000	.1250	.0839	.0737	.3675	.3675	.3675	0.740	1.	0.	0	5=50 16=25 7=25
		13 Nov 1990	31				.1250	.0839	.0737	.3675				.	.	.		

Recommendations: 35 and 89 - Breed

45 - Move to SD-WAP to breed with 106.

Move 137 from San Francisco to breed with 35 then return her.

Move either female 138 or 139 from NRP-WASH to L.A. after it produces offspring with Philadelphia male 10

Masterplan Report
INDIAN RHINOCEROS Studbook
(*Rhinoceros unicornis*)

LIVING POPULATION AT: SAN DIEGO WILD ANIMAL PARK

SD-WAP

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	F	MK	KV	GU-All	Vx	Live Sibs	Repro Offspr	Founder Representation	
		Arrival			Social	Known	[unkns = founders] [unknowns removed]			GU-CB		Live Offspr	Repro Offspr		
26	M	31 Aug 1962	5		1.0000	1.0000	.0000	.1521	.1442	.0010	0.160	0	1	0	7=50 5=50
		26 Apr 1972	7		1.0000	1.0000	.0000	.1521	.1442	.0010	0.160	0	1	0	7=50 5=50
					1.0000	1.0000	.0000	.1521	.1442	.0010	0.160	0	1	0	7=50 5=50
29	F	10 Jul 1963	24		1.0000	1.0000	.0000	.0792	.0705	.0350	0.000	4	1	0	82=50 24=50
		26 Apr 1972	82		1.0000	1.0000	.0000	.0792	.0705	.0350	0.000	4	1	0	82=50 24=50
					1.0000	1.0000	.0000	.0792	.0705	.0350	0.000	4	1	0	82=50 24=50
99	F	19 Mar 1978	26		1.0000	1.0000	.0000	.1448	.1341	.0000	0.640	4	2	0	7=25 5=25 82=25 24=25
		19 Mar 1978	29		1.0000	1.0000	.0000	.1448	.1341	.0000	0.640	4	2	0	7=25 5=25 82=25 24=25
					1.0000	1.0000	.0000	.1448	.1341	.0000	0.640	4	2	0	7=25 5=25 82=25 24=25
106	M	15 May 1981	76		1.0000	1.0000	.0000	.0500	.0580	.0585	1.560	3	1	0	77=50 76=50
		29 Jun 1985	77		1.0000	1.0000	.0000	.0500	.0580	.0585	1.560	3	1	0	77=50 76=50
					1.0000	1.0000	.0000	.0500	.0580	.0585	1.560	3	1	0	77=50 76=50
130	F	18 Jan 1985	26		1.0000	1.0000	.2500	.1651	.1552	.0000	1.160	5	2	0	7=37.5 5=37.5 82=12.5
		18 Jan 1985	99		1.0000	1.0000	.2500	.1651	.1552	.0000	1.160	5	2	0	7=37.5 5=37.5 82=12.5
					1.0000	1.0000	.2500	.1651	.1552	.0000	1.160	5	2	0	7=37.5 5=37.5 82=12.5
143	F	26 May 1987	26		1.0000	1.0000	.2500	.1651	.1581	.0000	1.440	5	3	0	7=37.5 5=37.5 82=12.5
		26 May 1987	99		1.0000	1.0000	.2500	.1651	.1581	.0000	1.440	5	3	0	7=37.5 5=37.5 82=12.5
					1.0000	1.0000	.2500	.1651	.1581	.0000	1.440	5	3	0	7=37.5 5=37.5 82=12.5
180	M	27 Jan 1990	26		1.0000	1.0000	.0000	.1240	.1185	.0000	1.790	3	3	0	7=25 5=25 82=25 24=25
		27 Jan 1990	29		1.0000	1.0000	.0000	.1240	.1185	.0000	1.790	3	3	0	7=25 5=25 82=25 24=25
					1.0000	1.0000	.0000	.1240	.1185	.0000	1.790	3	3	0	7=25 5=25 82=25 24=25
182	F	20 Jul 1990	106		1.0000	1.0000	.0000	.1148	.1155	.0000	1.640	3	0	0	77=25 76=25 7=18.8 5=18.8
		20 Jul 1990	130		1.0000	1.0000	.0000	.1148	.1155	.0000	1.640	3	0	0	77=25 76=25 7=18.8 5=18.8
					1.0000	1.0000	.0000	.1148	.1155	.0000	1.640	3	0	0	77=25 76=25 7=18.8 5=18.8
184	M	28 Dec 1990	106		1.0000	1.0000	.0000	.1057	.1067	.0000	1.720	2	2	0	77=25 76=25 7=12.5 5=12.5
		28 Dec 1990	99		1.0000	1.0000	.0000	.1057	.1067	.0000	1.720	2	2	0	77=25 76=25 7=12.5 5=12.5
					1.0000	1.0000	.0000	.1057	.1067	.0000	1.720	2	2	0	77=25 76=25 7=12.5 5=12.5
188	M	22 Dec 1991	106		1.0000	1.0000	.0000	.1148	.1170	.0000	1.660	2	2	0	77=25 76=25 7=18.8 5=18.8
		22 Dec 1991	143		1.0000	1.0000	.0000	.1148	.1170	.0000	1.660	2	2	0	77=25 76=25 7=18.8 5=18.8
					1.0000	1.0000	.0000	.1148	.1170	.0000	1.660	2	2	0	77=25 76=25 7=18.8 5=18.8
T9002	F	7 Sep 1993	26		1.0000	1.0000	.3750	.1659	.1597	.0000	1.570	5	2	0	7=43.8 5=43.8 82=6.3
		7 Sep 1993	143		1.0000	1.0000	.3750	.1659	.1597	.0000	1.570	5	2	0	7=43.8 5=43.8 82=6.3
					1.0000	1.0000	.3750	.1659	.1597	.0000	1.570	5	2	0	7=43.8 5=43.8 82=6.3
T9003	M	17 Mar 1994	106		1.0000	1.0000	.0000	.1148	.1132	.0000	1.210	2	1	0	77=25 76=25 7=18.8 5=18.8
		17 Mar 1994	130		1.0000	1.0000	.0000	.1148	.1132	.0000	1.210	2	1	0	77=25 76=25 7=18.8 5=18.8
					1.0000	1.0000	.0000	.1148	.1132	.0000	1.210	2	1	0	77=25 76=25 7=18.8 5=18.8

Masterplan Report
 INDIAN RHINOCEROS Studbook
 (*Rhinoceros unicornis*)

LIVING POPULATION AT: SAN DIEGO WILD ANIMAL PARK

SD-WAP

<<< Restricted >>>

Recommendations:

- 26 - Move to The Wilds - Maintain. Do not breed
- 29 - Move to The Wilds - Breed with 87 from Milwaukee
- 99 - Maintain. Do not breed
- 106 - Breed with 137 from San Francisco
- 130 - Maintain. Do not breed
- 143 - Maintain. Do not breed
- 180 - Move to Rolling Hills - Maintain. Do not breed
- 182 - Move to Stuttgart
- 184 - Move to Rolling Hills
- 188 - Maintain
- T9002 - Move to San Francisco then to India in exchange for excess captive male unrelated to SSP population
- T9003 - Maintain. Do not breed
- 45 - Move to SD-WAP from L.A.
- 136 - Move to SD-WAP from San Francisco

LIVING POPULATION AT: SAN DIEGO ZOOLOGICAL GARDEN

SANDIEGOZ

Stud #	Sex	Birth Date	Arrival	Sire Dam	Loc ID Social	Genome Known	F [unks = founders] [unknowns removed]	MK KV	GU-All GU-CB	Vx	Live Offspr	Repro Offspr	Founder Representation					
146	M	22 May 1988	26			1.0000	.0000	.1240	.1193	.0000	1.920	3.	3.	0	7=25	5=25	82=25	24=25
		13 Sep 1990	29			.0000	.1240	.1193	.0000									

Recommendations:

- 146 - Move to Rolling Hills - Maintain. Do not breed

Masterplan Report
 INDIAN RHINOCEROS Studbook
 (Rhinoceros unicornis)

LIVING POPULATION AT: SAN FRANCISCO ZOOLOGICAL GARDENS

SAN FRAN

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	F	MK	KV	GU-All	Vx	Live Sibs	Repro Offspr	Founder Representation
		Arrival	Dam	Social	Known	[unknowns removed]	[unks = founders]	[unknowns removed]	GU-CB	GU-CB		Live Offspr	Repro Offspr	
136	M	~ Apr 1986	WILD		1.0000	.0000	.0000	.0000	1.0000	1.0000	2.060	.	.	.
		26 May 1987	WILD			.0000	.0000	.0000	.	.	.	.	.	.
137	F	~ Oct 1986	WILD		1.0000	.0000	.0000	.0000	1.0000	1.0000	1.300	.	.	.
		26 May 1987	WILD			.0000	.0000	.0000	.	.	.	.	.	.

Recommendations:

136 - Maintain

137 - Move to Los Angeles - Breed with 35

T9002 to be received from San Diego Wild Anial Park until she moves onto India

LIVING POPULATION AT: NATIONAL ZOOLOGICAL PARK

NZP-WASH

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	F	MK	KV	GU-All	Vx	Live Sibs	Repro Offspr	Founder Representation
		Arrival	Dam	Social	Known	[unks = founders]	[unknowns removed]	[unknowns removed]	GU-CB	GU-CB		Live Offspr	Repro Offspr	
101	M	8 Aug 1980	26		1.0000	.0000	.1240	.1168	.0000	.0000	1.520	3.	3.	0
		25 Jun 1985	29			.0000	.1240	.1168	.0000	.0000				7=25† 5=25† 24=25†
138	F	~ Mar 1986	WILD		1.0000	.0000	.0000	.0000	1.0000	1.0000	1.300	.	.	.
		27 May 1987	WILD			.0000	.0000	.0000	.	.	.	.	.	.
139	F	~ Nov 1986	WILD		1.0000	.0000	.0000	.0000	1.0000	1.0000	1.440	.	.	.
		27 May 1987	WILD			.0000	.0000	.0000	.	.	.	.	.	.

Recommendations:

101 - Maintain. Do not breed

138, 139 - Sequentially move to Philadelphia to breed with 10. Return to NZP-WASH after breeding.
 Move 138 or 139 to L.A. after offspring produced.

Masterplan Report
INDIAN RHINOCEROS Studbook
(*Rhinoceros unicornis*)

LOWRY

LIVING POPULATION AT: LOWRY PARK ZOOLOGICAL GARDEN

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F	MK	KV	GU-All	GU-CB	Vx	Restricted >>			Founder Representation		
														Live Sibs	Live Offspr	Repro Offspr			
116	M	1 May 1983	26			1.0000	.0000	.1240	.1186	.0000	.0000	1.820	3.	3.	0	7=25	5=25	82=25	24=25
		23 Jun 1986	29				.0000	.1240	.1186	.0000									

Recommendations:

116 - Maintain. Do not breed.

METROZOO

LIVING POPULATION AT: MIAMI METROZOO

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F	MK	KV	GU-All	GU-CB	Vx	Restricted >>			Founder Representation		
														Live Sibs	Live Offspr	Repro Offspr			
49	M	1 Jun 1969	WILD			1.0000	.0000	.0000	.0000	.0000	1.000	1.080							
		23 Apr 1970	WILD				.0000	.0000	.0000	.0000									
50	F	Nov 1969	WILD			1.0000	.0000	.0000	.0000	.0000	1.000	0.340							
		29 Mar 1990	WILD				.0000	.0000	.0000	.0000									
126	M	3 Nov 1985	10			1.0000	.0000	.0714	.0794	.0000	.0000	2.060	2.	0.	0	10=50	7=25	18=25	
		1 Jan 1989	80				.0000	.0714	.0794	.1210									

Recommendations:

- 49 - Move to NY Bronx - Breed with 66
- 50 - Move to NY Bronx - Breed with 83
- 126 - Maintain. Do not breed

Masterplan Report
INDIAN RHINOCEROS Studbook
(*Rhinoceros unicornis*)

LIVING POPULATION AT: NEW YORK ZOOLOGICAL PARK

NY BRONX

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	Known	F	MK	KV	GU-All	Vx	Live Offspr	Repro Offspr	Founder Representation	
		Arrival	Dam	Social				[unks = founders]	[unknowns removed]		GU-CB					
53	M	16 Apr 1971	1			1.0000		.0000	.0292	.0243	.4820	1.330	0.	1.	0	11=50% 1=50%
		30 May 1990	11					.0000	.0292	.0243	.4820					
66	F	~ 1974	WILD			1.0000		.0000	.0167	.0181	.2545	0.470	0.	2.	0	
		30 Jan 1975	WILD					.0000	.0167	.0181						
67	F	~ 1974	WILD			1.0000		.0000	.0000	.0000	1.000	0.470	0.	0.	0	
		30 Jan 1975	WILD					.0000	.0000	.0000						
83	M	18 Feb 1976	18			1.0000		.0000	.0979	.0971	.0275	1.700	1.	3.	0	18=50% 7=25% 5=25%
		23 Dec 1983	31					.0000	.0979	.0971	.0275		0.	2.	0	
131	F	9 Apr 1986	83			1.0000		.0000	.0656	.0657	.0000	1.300	0.	1.	0	66=50% 18=25% 7=12.5% 5=12.5%
		9 Apr 1986	66					.0000	.0656	.0657	.2455					

Recommendations:

- 53 - Breed with 131
- 66 - Breed with 49 from Miami
- 67 - Maintain. Do not breed
- 83 - Breed with 50 from Miami
- 131 - Breed with 53
- 49 - Move to NY Bronx from Miami
- 50 - Move to NY Bronx from Miami

Masterplan Report
INDIAN RHINOCEROS Studbook
(Rhinoceros unicornis)

BUFFALO

LIVING POPULATION AT: BUFFALO ZOOLOGICAL GARDENS

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F (unks = founders)	MK (unks = founders removed)	KV	GU-All	GU-CB	Vx	Live Sibs	Live Offspr	Repro Offspr	Founder Representation
187	M	24 Jul 1991	10				1.0000	.0000	.0714	.0773	.0000	.0000	1.720	2	0	0	10=50% 7=25% 18=25%
		21 Jul 1992	80					.0000	.0714	.0773	.1195						

Recommendations:

187 - Maintain.

CINCINNATI

LIVING POPULATION AT: CINCINNATI ZOO & BOTANICAL GARDEN

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F (unks = founders)	MK (unks = founders removed)	KV	GU-All	GU-CB	Vx	Live Sibs	Live Offspr	Repro Offspr	Founder Representation
147	M	14 Aug 1988	10				1.0000	.0000	.0714	.0785	.0000	.0000	1.920	2	0	0	10=50% 7=25% 18=25%
		24 Oct 1989	80					.0000	.0714	.0785	.1185						

Recommendations:

147 - Pair with 189. Breed as soon as old enough.

189 - Move to Cincinnati from Toronto

Masterplan Report
 INDIAN RHINOCEROS Studbook
 (Rhinoceros unicornis)

OKLAHOMA

LIVING POPULATION AT: OKLAHOMA CITY ZOOLOGICAL PARK

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	F	MK	KV	GU-All	GU-CB	Vx	Live Sibs	Live Offspr	Repro Offspr	Founder Representation
					Known	[unknowns removed]	[unknowns removed]	[unknowns removed]	[unknowns removed]							
125	M	11 Aug 1985	35		1.0000	.0000	.0167	.0254	.5000	2.050						46=50 35=50
		14 Nov 1990	46			.0000	.0167	.0254	1.000							
161	F	9 May 1989	83		1.0000	.0000	.0656	.0676	.0000	1.620	0.1	0	66=50 18=25 7=12.5 5=12.5			
		8 Nov 1993	66			.0000	.0656	.0676	.2455							

Recommendations:

- 125 - Move to Ft Worth - Breed with 191
- 161 - Maintain. Do not breed
- 190 - Move to OKC from Ft Worth - Maintain. Do not breed

PHILADELPHIA

LIVING POPULATION AT: PHILADELPHIA ZOOLOGICAL GARDENS

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Genome	F	MK	KV	GU-All	GU-CB	Vx	Live Sibs	Live Offspr	Repro Offspr	Founder Representation
					Known	[unknowns removed]	[unknowns removed]	[unknowns removed]	[unknowns removed]							
10	M	1 Jan 1955	WILD		1.0000	.0000	.0250	.0353	.1410	0.000						
		14 Sep 1955	WILD			.0000	.0250	.0353					3.0	0.0		
80	F	10 Oct 1975	18		1.0000	.0000	.1010	.0979	.0160	0.470	3.1	0	7=50 18=50			
		6 Nov 1979	7			.0000	.1010	.0979	.0160				3.0	0.0		

Recommendations:

- 10 - Breed with NZP-WASH females 138, 139 sequentially. Return females once bred
- 80 - Maintain. Do not breed
- 138, 139 - Move to Philadelphia from NZP-WASH sequentially to be bred by 10

Masterplan Report
 INDIAN RHINOCEROS Studbook
 (Rhinoceros unicornis)

FORTWORTH

LIVING POPULATION AT: FORT WORTH ZOOLOGICAL PARK

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F [unks = founders] [unknowns removed]	MK [unks = founders] [unknowns removed]	KV	GU-All	GU-CB	Vx	Live Offspr	Repro Offspr	Founder Representation
190	M	6 Jun 1989	WILD	WILD	1.0000		1.0000	.0000	.0000	.0000	1.000	1.000	1.850	.	.	.
		10 May 1990	WILD					.0000	.0000	.0000				.	.	.
191	F	6 Jun 1989	WILD		1.0000		1.0000	.0000	.0000	.0000	1.000	1.000	1.620	.	.	.
		10 May 1990	WILD					.0000	.0000	.0000				.	.	.

Recommendations:

- 190 - Move to OKC - Maintain. Do not breed
- 191 - Breed with OKC male 125
- 125 - Move to Ft Worth from OKC

MILWAUKEE

LIVING POPULATION AT: MILWAUKEE COUNTY ZOOLOGICAL GARDENS

Stud #	Sex	Birth Date	Sire	Dam	Loc ID	Social	Genome Known	F [unks = founders] [unknowns removed]	MK [unks = founders] [unknowns removed]	KV	GU-All	GU-CB	Vx	Live Offspr	Repro Offspr	Founder Representation
87	M	26 Jan 1978	18		1.0000		1.0000	.2500	.0797	.0797	.0850	.0850	1.610	1.	2.	0
		31 Oct 1991	56					.2500	.0797	.0797				.	.	.

Recommendations:

- 87 - Move to the Wilds - Breed with 29

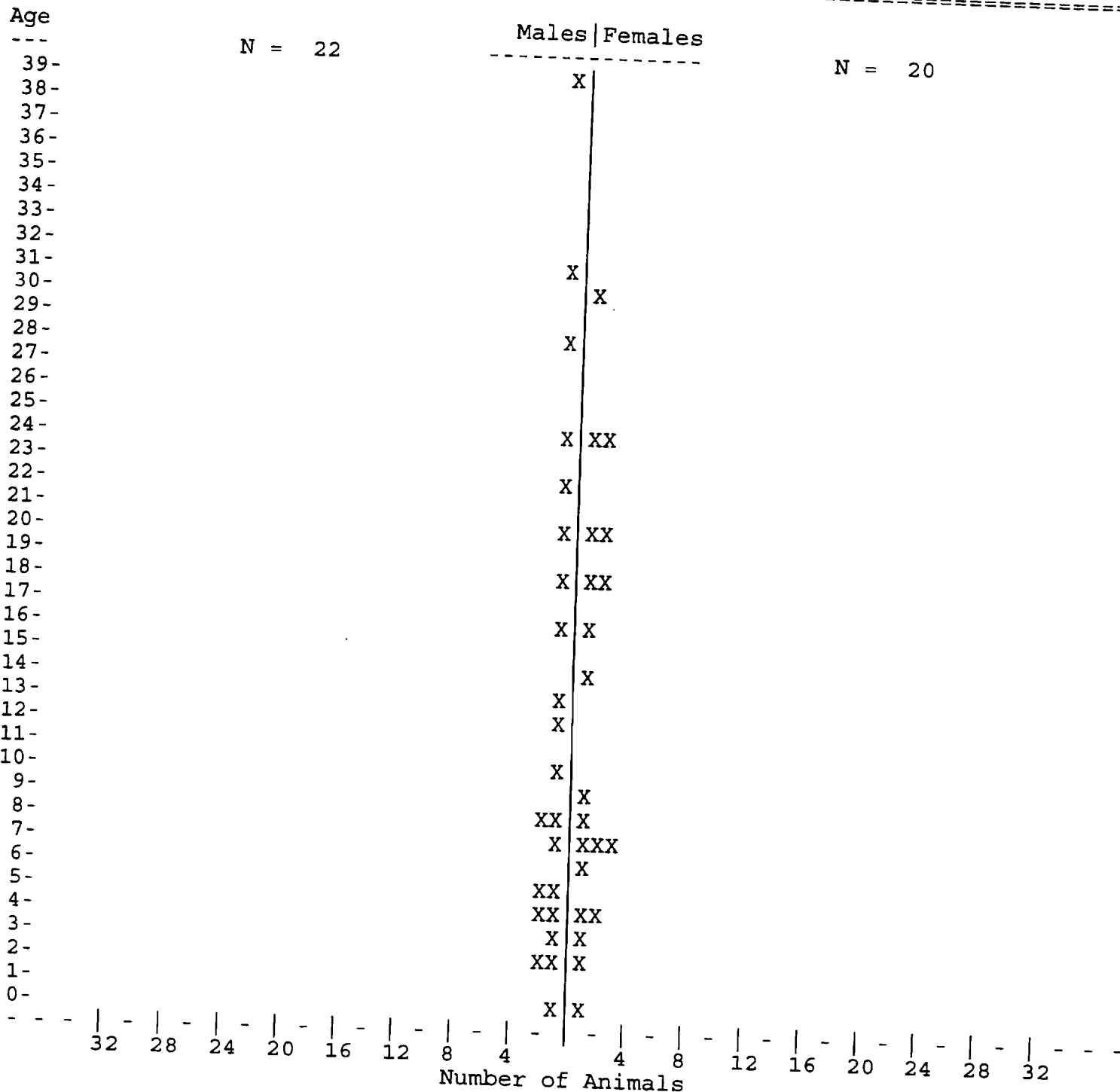
APPENDIX 1

DEMOGRAPHIC ANALYSIS

Age Pyramid Report
INDIAN RHINOCEROS Studbook

Restricted to:
Locations: N.AMERICA/
Dates: As of End of 22/03/1994 <= date

Taxon Name: RHINOCEROS UNICORNIS



X >>> Specimens of known sex...
? >>> Specimens of unknown sex...

Age Pyramid Report

Restricted to: INDIAN RHINOCEROS Studbook

Page

Locations: N.AMERICA/

Dates: As of End of 22/03/1994 <= date

=====
Taxon Name: RHINOCEROS UNICORNIS
=====Age Studbook Numbers >>> Male

39	10	
38		
37		
36		
35		
34		
33		
32		
31	26	
30		
29		
28	35	
27		
26		
25		
24	49	
23		
22	53	
21		
20	69	
19		
18	83	
17		
16	87	
15		
14		
13	101	
12	106	
11		
10	116	
9		
8	125	126
7	136	
6		
5	146	147
4	180	190
3	184	
2	187	188
1		
0	T9003	

Total= 22

Age Pyramid Report

Restricted to: INDIAN RHINOCEROS Studbook

Page 3

Locations: N.AMERICA/

Dates: As of End of 22/03/1994 <= date

=====
Taxon Name: RHINOCEROS UNICORNIS
=====

Age Studbook Numbers >>> Female

39			
38			
37			
36			
35			
34			
33			
32			
31			
30	29		
29			
28			
27			
26			
25			
24	45	50	
23			
22			
21			
20	66	67	
19			
18	79	80	
17			
16	99		
15			
14	89		
13			
12			
11			
10			
9	130		
8	138		
7	131	137	139
6	143		
5			
4	161	191	
3	182		
2	189		
1			
0	T9002		

Total= 20

4 Apr 1994 7 Feb 1994

Crude Demographic Parameters

Restricted to:

INDIAN RHINOCEROS Studbook

Page 1

Locations: N.AMERICA/

Dates: During date <= 31/12/1993

```

=====
Census          Crude Demographics
(M.F.?)        CBR  CIR  CDR  CDRn  CER  CRC      %>=F2
=====
31 Dec 1993  22.20.0  (42)  5%  0%  2%  50%  0%  1.024  31%
31 Dec 1992  22.19.0  (41)  10%  0%  10% 100%  0%  1.000  29%
31 Dec 1991  22.19.0  (41)  8%  0%  0%  0%  0%  1.079  29%
31 Dec 1990  20.18.0  (38)  9%  6%  0%  0%  0%  1.152  26%
31 Dec 1989  17.16.0  (33)  6%  0%  6%  50%  0%  1.000  21%
31 Dec 1988  18.15.0  (33)  6%  0%  3%  0%  0%  1.031  21%
31 Dec 1987  16.16.0  (32)  7%  14%  7%  50%  0%  1.143  19%
31 Dec 1986  16.12.0  (28)  7%  0%  7%  50%  0%  1.000  18%
31 Dec 1985  17.11.0  (28)  16%  0%  4%  0%  0%  1.120  21%
31 Dec 1984  14.11.0  (25)  4%  0%  4%  100%  0%  1.000  16%
31 Dec 1983  14.11.0  (25)  4%  0%  4%  0%  0%  1.042  16%
31 Dec 1982  13.11.0  (24)  14%  0%  5%  33%  0%  1.091  12%
31 Dec 1981  12.10.0  (22)  5%  0%  0%  0%  0%  1.048  9%
31 Dec 1980  11.10.0  (21)  5%  0%  5%  0%  0%  1.000  10%

```


Crude Demographic Parameters

INDIAN RHINOCEROS Studbook

Page 2

Restricted to:

Locations: N.AMERICA/

Dates: During date <= 31/12/1993

```

=====
Census          Crude Demographics
(M.F.?)         CBR  CIR  CDR  CDRn  CER  CRC          %>=F2
=====

```

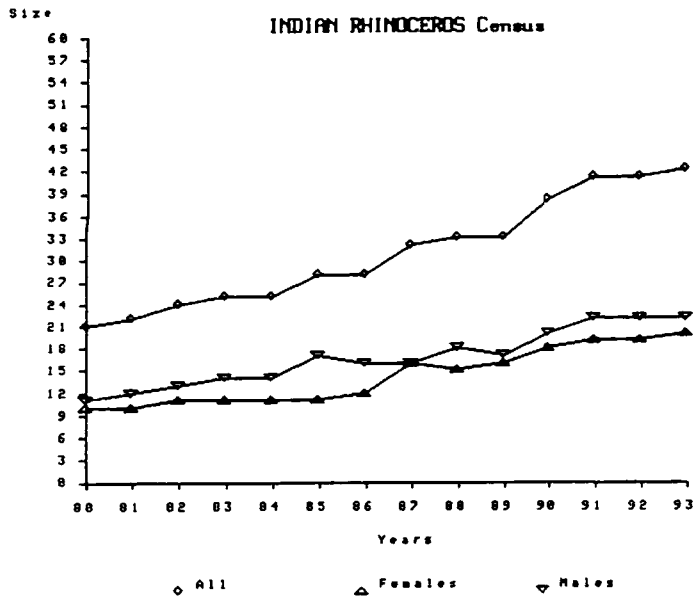
Explanatory Notes

=====

Census - Live count as of end of year (Male.Female.Unknown).

Crude Demographics>

- CBR - Crude birth rate (births per 100).
- CIR - Crude import rate (imports per 100).
- CDR - Crude death rate (deaths per 100).
- CDRn - Crude death rate of neonates (neonatal deaths per 100 births).
- CER - Crude export rate (exports per 100).
- CRC - Crude rate of change (actual observed annual growth rate).
- %>=F2 - Percent living in second or higher generation of captivity.



Fecundity and Mortality Report

INDIAN RHINOCEROS Studbook

Page 1

Restricted to:

Locations: N.AMERICA/

Dates: During 01/01/1984 <= date

=====
Taxon Name: RHINOCEROS UNICORNIS
=====

Age Class	Fecundity [Mx]...				Mortality [Qx]...			
	Male	N	Female	N	Male	N	Female	N
0- 1	0.00	9.5	0.00	7.4	0.35	14.5	0.35	11.4
1- 2	0.00	11.9	0.00	9.9	0.00	11.9	0.00	9.9
2- 3	0.00	11.4	0.00	10.3	0.00	11.4	0.00	10.3
3- 4	0.00	10.9	0.00	9.1	0.00	10.9	0.09	10.7
4- 5	0.00	9.4	0.06	8.3	0.00	9.4	0.00	8.3
5- 6	0.00	7.6	0.07	7.2	0.00	7.6	0.00	7.2
6- 7	0.00	7.0	0.25	7.9	0.00	7.0	0.00	7.9
7- 8	0.07	7.1	0.17	5.9	0.00	7.1	0.00	5.9
8- 9	0.00	6.1	0.11	4.4	0.00	6.1	0.00	4.4
9-10	0.20	5.1	0.23	4.4	0.00	5.1	0.00	4.4
10-11	0.25	5.9	0.08	6.0	0.00	5.9	0.00	6.0
11-12	0.20	5.0	0.08	6.0	0.00	5.0	0.00	6.0
12-13	0.19	5.2	0.25	6.0	0.00	5.2	0.00	6.0
13-14	0.11	4.7	0.00	6.0	0.00	4.7	0.00	6.0
14-15	0.00	4.4	0.07	7.3	0.00	4.4	0.00	7.3
15-16	0.00	5.0	0.13	8.0	0.00	5.0	0.00	8.0
16-17	0.00	4.2	0.14	7.0	0.00	4.2	0.00	7.0
17-18	0.12	4.1	0.07	7.0	0.00	4.1	0.00	7.0
18-19	0.00	4.1	0.00	6.2	0.00	4.1	0.00	6.2
19-20	0.13	4.0	0.00	4.8	0.00	4.0	0.20	5.0
20-21	0.16	3.2	0.00	2.9	0.00	3.2	0.00	2.9
21-22	0.00	3.7	0.00	3.0	0.00	3.7	0.00	3.0
22-23	0.25	4.0	0.00	3.0	0.00	4.0	0.00	3.0
23-24	0.00	3.0	0.17	3.0	0.00	3.0	0.00	3.0
24-25	0.35	2.8	0.26	1.9	0.00	2.8	0.00	1.9
25-26	0.17	3.0	0.00	1.0	0.00	3.0	0.00	1.0
26-27	0.00	3.0	0.50	1.0	0.00	3.0	0.00	1.0
27-28	0.14	3.7	0.00	1.0	0.00	3.7	0.00	1.0
28-29	0.00	3.2	0.00	1.0	0.00	3.2	0.00	1.0
29-30	0.25	4.0	0.50	1.0	0.00	4.0	0.00	1.0
30-31	0.16	3.1	0.00	0.7	0.50	4.0	0.00	0.7
31-32	0.31	1.6	0.00	0.0	0.00	1.6	0.00	0.0
32-33	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
33-34	0.50	1.0	0.00	0.0	0.00	1.0	0.00	0.0
34-35	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
35-36	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
36-37	0.50	1.0	0.00	0.0	0.00	1.0	0.00	0.0
37-38	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
38-39	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
39-40	0.00	0.3	0.00	0.0	0.00	0.3	0.00	0.0
40-41	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
41-42	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

T = 21.668
 Ro = 2.162
 lambda=1.04
 r = 0.036

T = 16.606
 Ro = 1.688
 lambda=1.03
 r = 0.032

30 day mortality: 35%
 (9 out of 26)

26 birth events to known age parents tabulated for Mx...
 13 death events of known age tabulated for Qx...

Smoothing pass 1

Age Class	Fecundity [Mx]...				Mortality [Qx]...			
	Male	N	Female	N	Male	N	Female	N
0- 1	0.00	9.5	0.00	7.4	0.35	14.5	0.35	11.4
1- 2	0.00	11.9	0.00	9.9	0.00	11.9	0.00	9.9
2- 3	0.00	11.4	0.00	10.3	0.00	11.4	0.03	10.3
3- 4	0.00	10.9	0.02	9.1	0.00	10.9	0.03	10.7
4- 5	0.00	9.4	0.04	8.3	0.00	9.4	0.03	8.3
5- 6	0.00	7.6	0.13	7.2	0.00	7.6	0.00	7.2
6- 7	0.02	7.0	0.16	7.9	0.00	7.0	0.00	7.9
7- 8	0.02	7.1	0.18	5.9	0.00	7.1	0.00	5.9
8- 9	0.09	6.1	0.17	4.4	0.00	6.1	0.00	4.4
9-10	0.15	5.1	0.14	4.4	0.00	5.1	0.00	4.4
10-11	0.22	5.9	0.13	6.0	0.00	5.9	0.00	6.0
11-12	0.21	5.0	0.14	6.0	0.00	5.0	0.00	6.0
12-13	0.17	5.2	0.11	6.0	0.00	5.2	0.00	6.0
13-14	0.10	4.7	0.11	6.0	0.00	4.7	0.00	6.0
14-15	0.04	4.4	0.07	7.3	0.00	4.4	0.00	7.3
15-16	0.00	5.0	0.11	8.0	0.00	5.0	0.00	8.0
16-17	0.04	4.2	0.11	7.0	0.00	4.2	0.00	7.0
17-18	0.04	4.1	0.07	7.0	0.00	4.1	0.00	7.0
18-19	0.08	4.1	0.02	6.2	0.00	4.1	0.07	6.2
19-20	0.10	4.0	0.00	4.8	0.00	4.0	0.07	5.0
20-21	0.10	3.2	0.00	2.9	0.00	3.2	0.07	2.9
21-22	0.14	3.7	0.00	3.0	0.00	3.7	0.00	3.0
22-23	0.08	4.0	0.06	3.0	0.00	4.0	0.00	3.0
23-24	0.20	3.0	0.14	3.0	0.00	3.0	0.00	3.0
24-25	0.17	2.8	0.14	1.9	0.00	2.8	0.00	1.9
25-26	0.17	3.0	0.25	1.0	0.00	3.0	0.00	1.0
26-27	0.10	3.0	0.17	1.0	0.00	3.0	0.00	1.0
27-28	0.05	3.7	0.17	1.0	0.00	3.7	0.00	1.0
28-29	0.13	3.2	0.17	1.0	0.00	3.2	0.00	1.0
29-30	0.14	4.0	0.17	1.0	0.17	4.0	0.00	1.0
30-31	0.24	3.1	0.17	0.7	0.17	4.0	0.00	0.7
31-32	0.16	1.6	0.00	0.0	0.17	1.6	0.00	0.0
32-33	0.27	1.0	0.00	0.0	0.00	1.0	0.00	0.0
33-34	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0
34-35	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0
35-36	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0
36-37	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0
37-38	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0
38-39	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
39-40	0.00	0.3	0.00	0.0	0.00	0.3	0.00	0.0
40-41	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
41-42	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
42-43	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

T = 22.043
 Ro = 2.232
 lambda=1.04
 r = 0.036

T = 16.664
 Ro = 1.704
 lambda=1.03
 r = 0.032

30 day mortality: 35%
 (9 out of 26)

26 birth events to known age parents tabulated for Mx...plus...

13 death events of known age tabulated for Qx...

WARNING: Values with small sample sizes (N) warrant less confidence...

Fecundity and Mortality Report

INDIAN RHINOCEROS Studbook

Page 1

Restricted to:

Locations: N.AMERICA/

Dates: During 01/01/1980 <= date

=====
Taxon Name: RHINOCEROS UNICORNIS
=====

Age Class	Fecundity [Mx]...				Mortality [Qx]...			
	Male	N	Female	N	Male	N	Female	N
0- 1	0.00	12.1	0.00	8.4	0.33	18.1	0.37	13.4
1- 2	0.00	13.2	0.00	11.1	0.00	13.9	0.00	11.1
2- 3	0.00	13.7	0.00	12.3	0.00	13.7	0.00	12.3
3- 4	0.00	12.3	0.00	11.1	0.00	12.3	0.08	12.7
4- 5	0.00	10.4	0.09	11.1	0.00	10.4	0.00	11.1
5- 6	0.00	9.2	0.05	10.2	0.00	9.2	0.00	10.2
6- 7	0.00	9.0	0.17	11.9	0.00	9.0	0.00	11.9
7- 8	0.06	9.0	0.10	9.9	0.00	9.0	0.00	9.9
8- 9	0.00	7.4	0.07	7.1	0.00	7.4	0.00	7.1
9-10	0.14	7.0	0.16	6.2	0.00	7.0	0.00	6.2
10-11	0.20	7.3	0.07	7.7	0.00	7.3	0.00	7.7
11-12	0.14	7.0	0.06	9.0	0.00	7.0	0.00	9.0
12-13	0.15	6.9	0.22	9.0	0.00	6.9	0.00	9.0
13-14	0.09	5.7	0.06	9.0	0.00	5.7	0.00	9.0
14-15	0.00	6.0	0.12	8.6	0.00	6.0	0.00	8.6
15-16	0.00	6.0	0.13	8.0	0.00	6.0	0.00	8.0
16-17	0.19	5.2	0.13	7.8	0.00	5.2	0.00	7.8
17-18	0.27	5.7	0.12	8.4	0.00	5.7	0.11	9.0
18-19	0.00	5.1	0.00	7.2	0.00	5.1	0.00	7.2
19-20	0.20	5.0	0.09	5.8	0.00	5.0	0.17	6.0
20-21	0.24	4.2	0.00	3.3	0.00	4.2	0.00	3.3
21-22	0.00	5.0	0.00	3.0	0.00	5.0	0.00	3.0
22-23	0.20	5.0	0.00	3.0	0.00	5.7	0.00	3.0
23-24	0.00	4.7	0.17	3.0	0.00	4.7	0.00	3.0
24-25	0.21	4.8	0.26	1.9	0.00	4.9	0.00	1.9
25-26	0.10	5.0	0.00	1.0	0.00	5.0	0.00	1.0
26-27	0.00	5.0	0.50	1.0	0.00	5.0	0.00	1.0
27-28	0.10	5.0	0.00	1.0	0.00	5.0	0.00	1.0
28-29	0.00	4.2	0.00	1.0	0.00	4.2	0.00	1.0
29-30	0.25	4.0	0.50	1.0	0.00	4.0	0.00	1.0
30-31	0.16	3.1	0.00	0.7	0.50	4.0	0.00	0.7
31-32	0.31	1.6	0.00	0.0	0.00	1.6	0.00	0.0
32-33	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
33-34	0.50	1.0	0.00	0.0	0.00	1.0	0.00	0.0
34-35	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
35-36	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
36-37	0.50	1.0	0.00	0.0	0.00	1.0	0.00	0.0
37-38	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
38-39	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0
39-40	0.00	0.3	0.00	0.0	0.00	0.3	0.00	0.0
40-41	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
41-42	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

T = 21.608

Ro = 2.195

lambda=1.04

r = 0.036

T = 17.188

Ro = 1.542

lambda=1.03

r = 0.025

30 day mortality: 34%

(11 out of 32)

32 birth events to known age parents tabulated for Mx...

16 death events of known age tabulated for Qx...

Age Class	Fecundity [Mx]...				Mortality [Qx]...				Smoothing pass
	Male	N	Female	N	Male	N	Female	N	1
0- 1	0.00	12.1	0.00	8.4	0.33	18.1	0.37	13.4	
1- 2	0.00	13.2	0.00	11.1	0.00	13.9	0.00	11.1	
2- 3	0.00	13.7	0.00	12.3	0.00	13.7	0.03	12.3	
3- 4	0.00	12.3	0.03	11.1	0.00	12.3	0.03	12.7	
4- 5	0.00	10.4	0.05	11.1	0.00	10.4	0.03	11.1	
5- 6	0.00	9.2	0.10	10.2	0.00	9.2	0.00	10.2	
6- 7	0.02	9.0	0.11	11.9	0.00	9.0	0.00	11.9	
7- 8	0.02	9.0	0.11	9.9	0.00	9.0	0.00	9.9	
8- 9	0.07	7.4	0.11	7.1	0.00	7.4	0.00	7.1	
9-10	0.11	7.0	0.10	6.2	0.00	7.0	0.00	6.2	
10-11	0.16	7.3	0.10	7.7	0.00	7.3	0.00	7.7	
11-12	0.16	7.0	0.12	9.0	0.00	7.0	0.00	9.0	
12-13	0.13	6.9	0.11	9.0	0.00	6.9	0.00	9.0	
13-14	0.08	5.7	0.13	9.0	0.00	5.7	0.00	9.0	
14-15	0.03	6.0	0.10	8.6	0.00	6.0	0.00	8.6	
15-16	0.06	6.0	0.13	8.0	0.00	6.0	0.00	8.0	
16-17	0.15	5.2	0.13	7.8	0.00	5.2	0.04	7.8	
17-18	0.15	5.7	0.08	8.4	0.00	5.7	0.04	9.0	
18-19	0.16	5.1	0.07	7.2	0.00	5.1	0.09	7.2	
19-20	0.15	5.0	0.03	5.8	0.00	5.0	0.06	6.0	
20-21	0.15	4.2	0.03	3.3	0.00	4.2	0.06	3.3	
21-22	0.15	5.0	0.00	3.0	0.00	5.0	0.00	3.0	
22-23	0.07	5.0	0.06	3.0	0.00	5.7	0.00	3.0	
23-24	0.14	4.7	0.14	3.0	0.00	4.7	0.00	3.0	
24-25	0.10	4.8	0.14	1.9	0.00	4.9	0.00	1.9	
25-26	0.10	5.0	0.25	1.0	0.00	5.0	0.00	1.0	
26-27	0.07	5.0	0.17	1.0	0.00	5.0	0.00	1.0	
27-28	0.03	5.0	0.17	1.0	0.00	5.0	0.00	1.0	
28-29	0.12	4.2	0.17	1.0	0.00	4.2	0.00	1.0	
29-30	0.14	4.0	0.17	1.0	0.17	4.0	0.00	1.0	
30-31	0.24	3.1	0.17	0.7	0.17	4.0	0.00	0.7	
31-32	0.16	1.6	0.00	0.0	0.17	1.6	0.00	0.0	
32-33	0.27	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
33-34	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
34-35	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
35-36	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
36-37	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
37-38	0.17	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
38-39	0.00	1.0	0.00	0.0	0.00	1.0	0.00	0.0	
39-40	0.00	0.3	0.00	0.0	0.00	0.3	0.00	0.0	
40-41	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	
41-42	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	
42-43	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	

T = 21.991
 Ro = 2.268
 lambda=1.04
 r = 0.037

T = 17.233
 Ro = 1.553
 lambda=1.03
 r = 0.026

30 day mortality: 34%
 (11 out of 32)

32 birth events to known age parents tabulated for Mx...plus...

16 death events of known age tabulated for Qx...

WARNING: Values with small sample sizes (N) warrant less confidence...

APPENDIX 2

GENETIC ANALYSIS

FOUNDER ANALYSIS FOR INDIAN/NEPALESE RHINO SSP

Mon Apr 04 19:26:44 1994

Founder representation in each living animal:

Founders listed across top, descendants down side.

Founder studbook numbers in parentheses indicate UNKNOWNs.

Studbook numbers beginning with P indicate wild or unknown founders that mated with studbook # without the P to produce CB offspring.

Founders	1	5	7	10	11	16	18
Founders	19	24	30	35	46	49	50
Founders	66	67	76	77	82	136	137
Founders	138	139	190	191	P30		

Founder contributions

1.2500	4.8750	6.1250	1.5000	1.2500	0.2500	3.5000
0.7500	2.3750	0.3750	0.5000	0.5000	0.0000	0.0000
1.0000	0.0000	1.5000	1.5000	2.3750	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.3750		

Fractional contributions

0.0417	0.1625	0.2042	0.0500	0.0417	0.0083	0.1167
0.0250	0.0792	0.0125	0.0167	0.0167	0.0000	0.0000
0.0333	0.0000	0.0500	0.0500	0.0792	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0125		

Number of living descendants

3	18	23	3	3	1	9
2	13	2	1	1	0	0
2	0	5	5	13	0	0
0	0	0	0	2		

GENE DROP ANALYSIS FOR INDIAN/NEPALESE RHINO SSP

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Studbook	Sire	Dam	Status	Prop. genome unique among living desc.	unique among all living
10 M	WILD	WILD	F		0.1295
26 M	5	7	A	0.0010	0.0010
29 F	24	82	A	0.0325	0.0325
35 M	WILD	WILD	F		0.5000
45 F	18	17	A	0.1365	0.1365
49 M	WILD	WILD	F		1.0000
50 F	WILD	WILD	F		1.0000
53 M	1	11	A	0.5275	0.5275
66 F	WILD	WILD	F		0.2600
67 F	WILD	WILD	F		1.0000
69 M	19	28	A	0.5000	0.5000
79 F	1	11	A	0.2510	0.2510
80 F	18	7	A	0.0130	0.0130
83 M	18	31	A	0.0295	0.0295
87 M	18	56	A	0.0910	0.0910
89 F	32	31	A	0.3665	0.3665
99 F	26	29	A	0.0000	0.0000
101 M	26	29	A	0.0000	0.0000
106 M	76	77	A	0.0690	0.0690
116 M	26	29	A	0.0000	0.0000
125 M	35	46	A	1.0000	0.5000
126 M	10	80	A	0.1235	0.0000
130 F	26	99	A	0.0000	0.0000
131 F	83	66	A	0.2400	0.0000
136 M	WILD	WILD	F		1.0000
137 F	WILD	WILD	F		1.0000
138 F	WILD	WILD	F		1.0000
139 F	WILD	WILD	F		1.0000
143 F	26	99	A	0.0000	0.0000
146 M	26	29	A	0.0000	0.0000
147 M	10	80	A	0.1165	0.0000
161 F	83	66	A	0.2400	0.0000
180 M	26	29	A	0.0000	0.0000
182 F	106	130	A	0.0000	0.0000
184 M	106	99	A	0.0000	0.0000
187 M	10	80	A	0.1305	0.0000
188 M	106	143	A	0.0000	0.0000
189 F	69	79	A	0.0000	0.0000
190 M	WILD	WILD	F		1.0000
191 F	WILD	WILD	F		1.0000
T9002 F	26	143	A	0.0000	0.0000
T9003 M	106	130	A	0.0000	0.0000

26 Founders

30 Living descendants

61 In analysis

FOUNDER ALLELE REPRESENTATION

Founder	Retention	%Representation	Target	Difference
1 M	0.758	4.132	3.796	-0.336
5 M	0.829	16.338	4.149	-12.190
7 F	0.919	20.247	4.602	-15.645
10 ML	0.871	5.000	5.007	0.007
11 F	0.769	4.202	3.853	-0.348
16 F	0.248	0.828	1.244	0.416
18 M	0.947	11.687	4.742	-6.945
19 M	0.500	2.485	2.504	0.019
24 M	0.500	7.982	2.504	-5.478
30 F	0.249	1.275	1.249	-0.026
35 ML	0.500	1.667	5.007	3.341
46 F	0.500	1.667	2.504	0.837
49 ML	0.000	0.000	5.007	5.007
50 FL	0.000	0.000	5.007	5.007
66 FL	0.740	3.333	5.007	1.674
67 FL	0.000	0.000	5.007	5.007
76 M	0.500	4.892	2.504	-2.388
77 F	0.500	5.108	2.504	-2.605
82 F	0.500	7.918	2.504	-5.415
136 ML	0.000	0.000	5.007	5.007
137 FL	0.000	0.000	5.007	5.007
138 FL	0.000	0.000	5.007	5.007
139 FL	0.000	0.000	5.007	5.007
190 ML	0.000	0.000	5.007	5.007
191 FL	0.000	0.000	5.007	5.007
P30 M	0.251	1.240	1.254	0.014

GENETIC SUMMARY

	LIVING DESCENDANT POPULATION	POTENTIAL
Number of founders:	17	26
Mean retention:	0.593	0.768
Founder genomes surviving:	10.081	19.970
Founder Genome Equivalents:	5.354	19.970
Fraction of wild gene diversity retained:	0.907	0.975
Fraction of wild gene diversity lost:	0.093	0.025
Mean inbreeding coefficient:	0.041	

INBREEDING COEFFICIENTS AND MEAN KINSHIPS FOR INDIAN/NEPALESE RHINO SSP

Mon Apr 04 19:26:44 1994

Inbreeding and kinship calculations assume UNKNOWNs are founders.

MEAN KINSHIP OF LIVING ANIMALS TO LIVING NON-FOUNDERS

STUDBOOK	SIRE	DAM	INBREEDING	MEAN KINSHIP	KINSHIP VALUE	GENOME KNOWN
10 M	WILD	WILD	F = 0.0000	mk = 0.0250	kv = 0.0353	1.0000
26 M	5	7	F = 0.0000	mk = 0.1521	kv = 0.1442	1.0000
29 F	24	82	F = 0.0000	mk = 0.0792	kv = 0.0705	1.0000
35 M	WILD	WILD	F = 0.0000	mk = 0.0083	kv = 0.0127	1.0000
45 F	18	17	F = 0.0000	mk = 0.0854	kv = 0.0741	1.0000
49 M	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
50 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
53 M	1	11	F = 0.0000	mk = 0.0292	kv = 0.0243	1.0000
66 F	WILD	WILD	F = 0.0000	mk = 0.0167	kv = 0.0181	1.0000
67 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
69 M	19	28	F = 0.0000	mk = 0.0250	kv = 0.0298	1.0000
79 F	1	11	F = 0.0000	mk = 0.0333	kv = 0.0239	1.0000
80 F	18	7	F = 0.0000	mk = 0.1010	kv = 0.0979	1.0000
83 M	18	31	F = 0.0000	mk = 0.0979	kv = 0.0971	1.0000
87 M	18	56	F = 0.2500	mk = 0.0797	kv = 0.0797	1.0000
89 F	32	31	F = 0.1250	mk = 0.0839	kv = 0.0737	1.0000
99 F	26	29	F = 0.0000	mk = 0.1448	kv = 0.1341	1.0000
101 M	26	29	F = 0.0000	mk = 0.1240	kv = 0.1168	1.0000
106 M	76	77	F = 0.0000	mk = 0.0500	kv = 0.0580	1.0000
116 M	26	29	F = 0.0000	mk = 0.1240	kv = 0.1186	1.0000
125 M	35	46	F = 0.0000	mk = 0.0167	kv = 0.0254	1.0000
126 M	10	80	F = 0.0000	mk = 0.0714	kv = 0.0794	1.0000
130 F	26	99	F = 0.2500	mk = 0.1651	kv = 0.1552	1.0000
131 F	83	66	F = 0.0000	mk = 0.0656	kv = 0.0657	1.0000
136 M	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
137 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
138 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
139 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
143 F	26	99	F = 0.2500	mk = 0.1651	kv = 0.1581	1.0000
146 M	26	29	F = 0.0000	mk = 0.1240	kv = 0.1193	1.0000
147 M	10	80	F = 0.0000	mk = 0.0714	kv = 0.0785	1.0000
161 F	83	66	F = 0.0000	mk = 0.0656	kv = 0.0676	1.0000
180 M	26	29	F = 0.0000	mk = 0.1240	kv = 0.1185	1.0000
182 F	106	130	F = 0.0000	mk = 0.1148	kv = 0.1155	1.0000
184 M	106	99	F = 0.0000	mk = 0.1057	kv = 0.1067	1.0000
187 M	10	80	F = 0.0000	mk = 0.0714	kv = 0.0773	1.0000
188 M	106	143	F = 0.0000	mk = 0.1148	kv = 0.1170	1.0000
189 F	69	79	F = 0.0000	mk = 0.0375	kv = 0.0367	1.0000
190 M	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
191 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
T9002 F	26	143	F = 0.3750	mk = 0.1659	kv = 0.1597	1.0000
T9003 M	106	130	F = 0.0000	mk = 0.1148	kv = 0.1132	1.0000

ORDERED LISTS OF MEAN KINSHIP BY SEX:

Rank	MALES	MK	Age	Known		FEMALES	MK	Age	Known	
1	49	0.0000	25	1.000	Miami	50	0.0000	24	1.000	Miami
2	136	0.0000	8	1.000	San Frn	67	0.0000	20	1.000	NY
3	190	0.0000	5	1.000	Ft Wrth	137	0.0000	8	1.000	San Frn
4	35	0.0083	28	1.000	L.A.	138	0.0000	8	1.000	NZP
5	125	0.0167	9	1.000	OKC	139	0.0000	7	1.000	NZP
6	10	0.0250	39	1.000	Phila	191	0.0000	5	1.000	Ft Wrth
7	69	0.0250	20	1.000	Trnto	66	0.0167	20	1.000	NY
8	53	0.0292	23	1.000	NY	79	0.0333	19	1.000	Trnto
9	106	0.0500	13	1.000	SDWP	189	0.0375	2	1.000	Trnto
10	126	0.0714	8	1.000	Miami	131	0.0656	8	1.000	NY
11	147	0.0714	6	1.000	Cin	161	0.0656	5	1.000	OKC
12	187	0.0714	3	1.000	Buf	29	0.0792	31	1.000	SDWAP
13	87	0.0797	16	1.000	Mlwk	89	0.0839	15	1.000	L.A.
14	83	0.0979	18	1.000	NY	45	0.0854	24	1.000	L.A.
15	184	0.1057	3	1.000	SDWAP	80	0.1010	18	1.000	Phila
16	188	0.1148	2	1.000	SDWAP	182	0.1148	4	1.000	SDWAP
17	T9003	0.1148	0	1.000	SDWAP	99	0.1448	16	1.000	SDWAP
18	101	0.1240	14	1.000	NZP	130	0.1651	9	1.000	SDWAP
19	116	0.1240	11	1.000	Lowry	143	0.1651	7	1.000	SDWAP
20	146	0.1240	6	1.000	SDZoo	T9002	0.1659	1	1.000	SDWAP
21	180	0.1240	4	1.000	SDWAP					
22	26	0.1521	32	1.000	SDWAP					

GENETIC SUMMARY OF POPULATION

Descendant population Mean Kinship:	0.0934
Gene Diversity:	0.9066
Founder Genome Equivalents:	5.3510
Desc. population mean Kinship Value:	0.0907
Gene Value:	0.9093

MATING CHOICES: Inbreeding coefficients for potential offspring.

Males across top, females down side.

Studbook numbers followed by U indicate partially unknown ancestry.

	10	26	35	49	53	69	83
29	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45	0.0000	0.1250	0.0000	0.0000	0.0000	0.0000	0.1875
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
79	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000
80	0.0000	0.1250	0.0000	0.0000	0.0000	0.0000	0.1875
89	0.0000	0.1875	0.0000	0.0000	0.0000	0.0000	0.1562
99	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0625
130	0.0000	0.3750	0.0000	0.0000	0.0000	0.0000	0.0938
131	0.0000	0.0625	0.0000	0.0000	0.0000	0.0000	0.2500
137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
138	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
143	0.0000	0.3750	0.0000	0.0000	0.0000	0.0000	0.0938
161	0.0000	0.0625	0.0000	0.0000	0.0000	0.0000	0.2500
182	0.0000	0.1875	0.0000	0.0000	0.0000	0.0000	0.0469
189	0.0000	0.0000	0.0000	0.0000	0.1250	0.2500	0.0000
191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
T9002	0.0000	0.4375	0.0000	0.0000	0.0000	0.0000	0.1094

	87	101	106	116	125	126	136
29	0.0000	0.2500	0.0000	0.2500	0.0000	0.0000	0.0000
45	0.2188	0.0625	0.0000	0.0625	0.0000	0.0938	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
79	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80	0.2500	0.0625	0.0000	0.0625	0.0000	0.2500	0.0000
89	0.0312	0.0938	0.0000	0.0938	0.0000	0.0312	0.0000
99	0.0312	0.2500	0.0000	0.2500	0.0000	0.0312	0.0000
130	0.0469	0.2500	0.0000	0.2500	0.0000	0.0469	0.0000
131	0.1094	0.0312	0.0000	0.0312	0.0000	0.0469	0.0000
137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
138	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
143	0.0469	0.2500	0.0000	0.2500	0.0000	0.0469	0.0000
161	0.1094	0.0312	0.0000	0.0312	0.0000	0.0469	0.0000
182	0.0235	0.1250	0.2500	0.1250	0.0000	0.0235	0.0000
189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
T9002	0.0547	0.2500	0.0000	0.2500	0.0000	0.0547	0.0000

	146	147	180	184	187	188	190
29	0.2500	0.0000	0.2500	0.1250	0.0000	0.0625	0.0000
45	0.0625	0.0938	0.0625	0.0312	0.0938	0.0469	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
79	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80	0.0625	0.2500	0.0625	0.0312	0.2500	0.0469	0.0000
89	0.0938	0.0312	0.0938	0.0469	0.0312	0.0704	0.0000
99	0.2500	0.0312	0.2500	0.2500	0.0312	0.1875	0.0000
130	0.2500	0.0469	0.2500	0.1875	0.0469	0.1875	0.0000
131	0.0312	0.0469	0.0312	0.0157	0.0469	0.0235	0.0000
137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
138	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
143	0.2500	0.0469	0.2500	0.1875	0.0469	0.3125	0.0000
161	0.0312	0.0469	0.0312	0.0157	0.0469	0.0235	0.0000
182	0.1250	0.0235	0.1250	0.2188	0.0235	0.2188	0.0000
189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
T9002	0.2500	0.0547	0.2500	0.1562	0.0547	0.2500	0.0000

T9003

29	0.0625
45	0.0469
50	0.0000
66	0.0000
67	0.0000
79	0.0000
80	0.0469
89	0.0704
99	0.1875
130	0.3125
131	0.0235
137	0.0000
138	0.0000
139	0.0000
143	0.1875
161	0.0235
182	0.2812
189	0.0000
191	0.0000
T9002	0.1875

APPENDIX 3

GENETIC EFFECTS HYPOTHETICAL MATINGS

EFFECTS OF HYPOTHETICAL FUTURE MATINGS

TOP 20 MATINGS CURRENT: GENE DIV=95.176% FGE=10.365

Studbook numbers followed by U indicate partially unknown ancestry.

MALE	AGE	MK	FEMALE	AGE	MK	F	GENE DIV	FGE	PAIRS CHOSEN	F
49	25	0.000	50	24	0.000	0.000	95.344	10.7393	35 x 137	0.000
136	8	0.015	67	20	0.000	0.000	95.315	10.6732	136 x 137	0.000
190	5	0.015	138	8	0.015	0.000	95.287	10.6079	136 x 137	0.000
35	28	0.020	139	7	0.015	0.000	95.277	10.5864	136 x 137	0.000
125	9	0.025	137	8	0.020	0.000	95.258	10.5434	10 x 138	0.000
106	13	0.030	191	5	0.020	0.000	95.248	10.5221	10 x 138	0.000
69	20	0.030	66	20	0.025	0.000	95.238	10.5009	10 x 139	0.000
10	39	0.035	189	2	0.041	0.000	95.198	10.4116	10 x 139	0.000
53	23	0.040	79	19	0.043	0.250	95.181	10.3752	35 x 191	0.000
87	16	0.048	131	8	0.047	0.109	95.160	10.3308	190 x 191	0.000
126	8	0.053	161	5	0.047	0.047	95.152	10.3128	190 x 191	0.000
147	6	0.053	29	31	0.048	0.000	95.151	10.3122	190 x 191	0.000
187	3	0.053	89	15	0.050	0.031	95.145	10.2994	69 x 79	0.000
83	18	0.059	45	24	0.051	0.188	95.129	10.2652	69 x 79	0.000
184	3	0.063	80	18	0.061	0.031	95.105	10.2148	125 x 138	0.000
188	2	0.069	182	4	0.069	0.219	95.075	10.1524	125 x 139	0.000
T9003	0	0.069	99	16	0.087	0.188	95.041	10.0830	53 x 66	0.000
101	14	0.074	130	9	0.099	0.250	95.006	10.0120	53 x 66	0.000
116	11	0.074	143	7	0.099	0.250	95.006	10.0120	53 x 66	0.000
146	6	0.074	T9002	1	0.100	0.250	95.005	10.0102	69 x 79	0.000

APPENDIX 4

TARGET POPULATION CALCULATIONS

CAPACITY CALCULATIONS FOR INDIAN/NEPALESE RHINO SSP

I. Existing Parameters and Objectives:

Capacity 3.0

=====

Effective Size and Population Size Necessary for Maintaining the
Specified Amount of Genetic Diversity for the Specified Amount of Time

No. of Years per Generation (T): 15.0 Annual Growth Rate (lambda): 1.040 % Diversity Retained to Date: 94.0 Effective Size of Population: 15.0 Estimated Ne/N Ratio: 0.50 Current Year: 10	PROGRAM GOALS: Length of Program (Years): 150 % Hetero. To Retain: 90.0 Growth rate per Generation: 1.80 # Generations during 150 Years: 10
---	--

Effective Size Required to Maintain 90.0% of the
Original Founder's Heterozygosity for 150 Years: Not Possible With

Actual Population Size Required (Based on Ne/N Ratio): These Parameters

=04/05/94===== j.ballou Feb'92 ==

Capacity 3.0

=====

ACTUAL POPULATION SIZES Required to Maintain Various Levels of
Heterozygosity for Various Time Periods Given a Current Ne of 15.0

		LENGTH OF PROGRAM (YEARS)					Model Parameters
		60	80	100	120	150	
	90.0	****	****	****	****	****	Lambda: 1.040
% Hetero.	85.0	46	62	84	132	188	Gen. Length: 15.0
To Be	80.0	26	32	40	56	74	Ne/N Ratio: 0.50
Retained							Het. to Date: 94.0
							Years Elapsed: 10

**** = Not Possible with these parameters

== 04/05/94 ===== j.ballou-NZP Feb 92 =

II. If Management of current breeders improves to add 2.2 more F.G.E.s and the potential Founders at Fort Worth (1.1), San Francisco (1.1) and Washington (0.2) reproduce and have 2 offspring each (i.e. adding .75 FGE each).

Capacity 3.0

=====

Effective Size and Population Size Necessary for Maintaining the Specified Amount of Genetic Diversity for the Specified Amount of Time

No. of Years per Generation (T):	15.0	PROGRAM GOALS:	
Annual Growth Rate (lambda):	1.040	Length of Program (Years):	150
% Diversity Retained to Date:	96.0	% Hetero. To Retain:	90.0
Effective Size of Population:	20.5		
Estimated Ne/N Ratio:	0.50	Growth rate per Generation:	1.80
Current Year:	10	# Generations during 150 Years:	10

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 150 Years: 173

Actual Population Size Required (Based on Ne/N Ratio): 346

=04/05/94===== j.ballou Feb'92 ===

Capacity 3.0

=====

ACTUAL POPULATION SIZES Required to Maintain Various Levels of Heterozygosity for Various Time Periods Given a Current Ne of 20.5

		LENGTH OF PROGRAM (YEARS)					Model Parameters	
		60	80	100	120	150		
% Hetero. To Be Retained	90.0	76	114	162	278	416	Lambda:	1.040
	85.0	34	42	52	72	96	Gen. Length:	15.0
	80.0	22	28	34	44	58	Ne/N Ratio:	0.50
							Het. to Date:	96.0
							Years Elapsed:	10

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III. If Management of current breeders improves to add 2.2 more F.G.E.s and the potential Founders at Fort Worth (1.1), San Francisco (1.1) and Washington (0.2) reproduce and 6 more founders are obtained fro the wild (or captivity in other Regions) have 2 offspring each (i.e. adding .75 FGE each).

Capacity 3.0

Effective Size and Population Size Necessary for Maintaining the Specified Amount of Genetic Diversity for the Specified Amount of Time

No. of Years per Generation (T):	15.0	PROGRAM GOALS:	
Annual Growth Rate (lambda):	1.040	Length of Program (Years):	150
% Diversity Retained to Date:	97.0	% Hetero. To Retain:	90.0
Effective Size of Population:	26.5		
Estimated Ne/N Ratio:	0.50	Growth rate per Generation:	1.80
Current Year:	10	# Generations during 150 Years:	10

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 150 Years: 78

Actual Population Size Required (Based on Ne/N Ratio): 156

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Capacity 3.0

ACTUAL POPULATION SIZES Required to Maintain Various Levels of Heterozygosity for Various Time Periods Given a Current Ne of 26.5

		LENGTH OF PROGRAM (YEARS)					Model Parameters	
		60	80	100	120	150		
% Hetero. To Be Retained	90.0	54	72	90	132	178	Lambda:	1.040
	85.0	30	38	46	62	80	Gen. Length:	15.0
	80.0	22	26	32	42	52	Ne/N Ratio:	0.50
							Het. to Date:	97.0
							Years Elapsed:	10

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IV. If Management of current breeders improves to add 2.2 more F.G.E.s and the potential Founders at Fort Worth (1.1), San Francisco (1.1) and Washington (0.2) reproduce and 6 more founders are obtained fro the wild (or captivity in other Regions) have 3 offspring each (i.e. adding .875 FGE each).

Capacity 3.0

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Effective Size and Population Size Necessary for Maintaining the Specified Amount of Genetic Diversity for the Specified Amount of Time

No. of Years per Generation (T):	15.0	PROGRAM GOALS:	
Annual Growth Rate (lambda):	1.040	Length of Program (Years):	150
% Diversity Retained to Date:	98.0	% Hetero. To Retain:	90.0
Effective Size of Population:	26.5		
Estimated Ne/N Ratio:	0.50	Growth rate per Generation:	1.80
Current Year:	10	# Generations during 150 Years:	10

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 150 Years: 63

Actual Population Size Required (Based on Ne/N Ratio): 126

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Capacity 3.0

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ACTUAL POPULATION SIZES Required to Maintain Various Levels of Heterozygosity for Various Time Periods Given a Current Ne of 26.5

		LENGTH OF PROGRAM (YEARS)					Model Parameters	
		60	80	100	120	150		
% Hetero. Retained	90.0	48	62	76	108	144	Lambda:	1.040
	85.0	28	36	42	58	74	Gen. Length:	15.0
	80.0	20	26	30	40	50	Ne/N Ratio:	0.50
							Het. to Date:	98.0
							Years Elapsed:	10

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BOX 1**SSP* CENTRAL DOGMA**

- I. The first priority is to breed individuals of lowest Mean Kinship (MK) which are underrepresented and, therefore, possess the rarest alleles in the population.
- II. Among individuals with low MK, the second priority is to breed those whose alleles may be lost soon. This prioritization should be determined by the manager's knowledge of individuals' age, health, and/or reproductive condition. In the absence of other information low Kinship Value (KV), printed on the Master Plan Report, can be used.
- III. During pairing, pair individuals according to the following ordered criteria:
 - 1ST mate individuals with roughly similar MK to avoid combining rare and common alleles in offspring which reduces long-term gene diversity.
 - 2ND mate individuals whose offspring will have low inbreeding coefficients (f), for the best probability of viable, healthy offspring.
 - 3RD maximize mating success based on the species' biology including suitable age of individuals, mate choice, social structure, etc.
 - 4TH minimize logistical difficulties of moves (e.g. distance, cost, quarantine).
 - 5TH maximize interinstitutional harmony and minimize political conflicts, hopefully this will never enter into the final decision which should be based upon science.