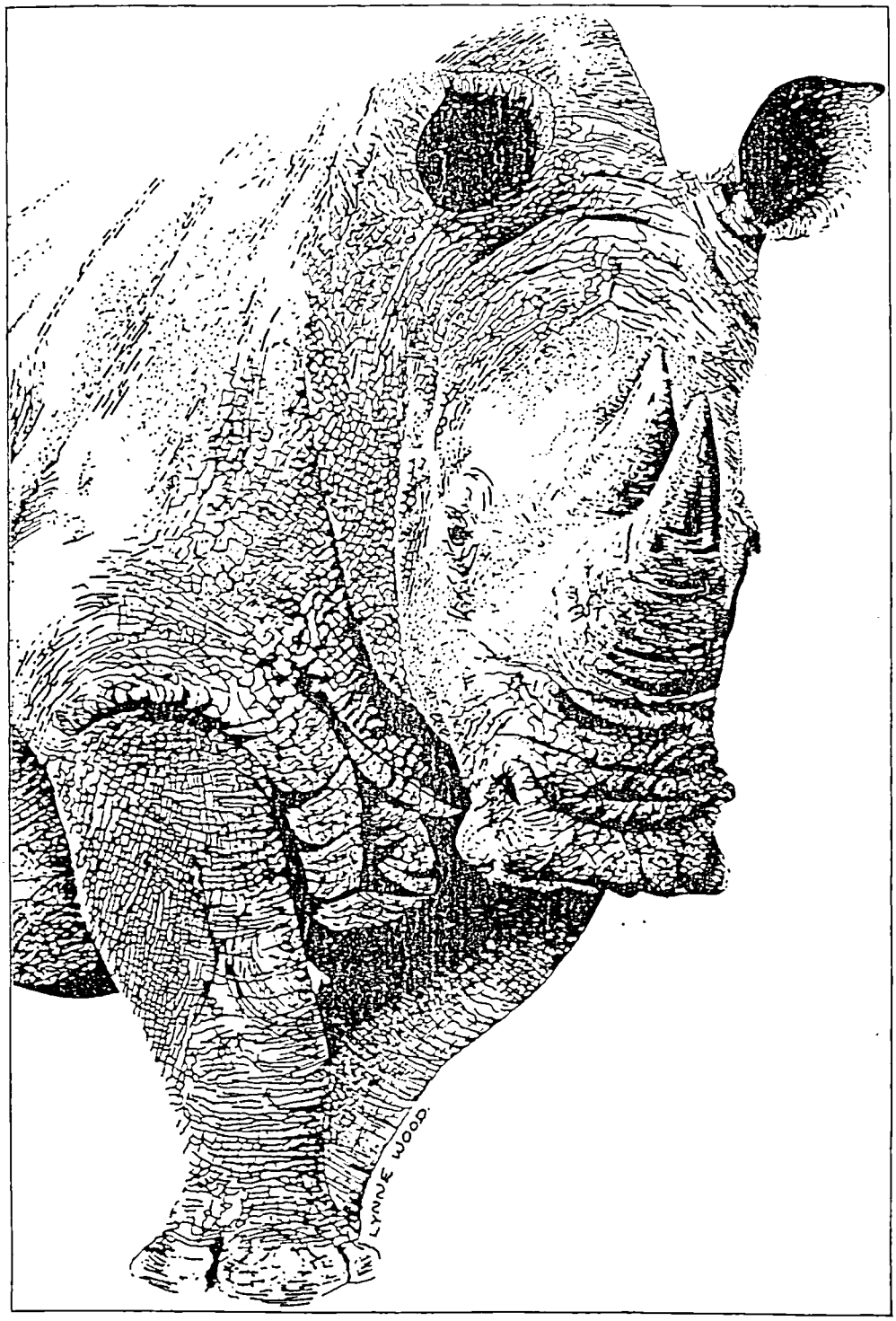
SOUTHERN WHITE RHINO
SPECIES MANAGEMENT PLAN



REVISION DRAFT (JULY 1993)

AUSTRALASIAN SPECIES MANAGEMENT PROGRAMME

CAPTIVE SPECIES MANAGEMENT PLAN FOR

SOUTHERN WHITE RHINO

(Ceratotherium simum simum)

This captive species management plan has been prepared to aid in the management of this species in captivity. The information contained has been collected from Zoo records, animal husbandry staff, text books, research papers etc. The captive population is managed via the Single Population Analysis and Record Keeping System (SPARKS) database. Any queries regarding the plan should be addressed to the Species Co-ordinator.

Prepared by: Paul Garland Date: 15 July 1993

(Stud-book Keeper)

Institution: Orana Park Wildlife Trust

Endorsed by: _____ Date: _____

(TAG Convenor)

Endorsed by Conservation Co-ordinator

Signature: _____ Date: _____

Approved by ASMP Directors

Signature: _____ Date: _____

ASMP

AUSTRALASIAN SPECIES MANAGEMENT PROGRAMME

MANAGEMENT PLAN - SOUTHERN WHITE RHINO

Version 1 June 1993

TABLE OF CONTENTS

CAPTIVE MANAGEMENT PLAN FOR SOUTHERN WHITE RHINO

1. INTRODUCTION

1.1 TAXONOMY

Common Name:	South White Rhinoceros (Ceratotherium simum simum)
Family:	Rhinocerotidae
Order:	Perissodactyla
Class:	Mammalia

Both the Southern and Northern White Rhino belong to the family of Rhinocerotidae, which also encompasses the Black Rhino and three Rhino species in Asia. There is now sufficient scientific evidence (O. Ryder AAZPA 1986) to confirm the Northern and Southern White Rhino as separate sub-species.

1.2 STATUS CLASSIFICATION

ASMP	: 3(2)
IUCN	: R
MACE/LANDE	: V
CITES	: 1
GCAP	: 90/100 I

1.3 CONSERVATION STATUS

The main wild populations of the Southern White Rhino are restricted to the Eastern Natal, South Africa, but it once occurred (prior to 1850) over much of Southern Africa, up into Zimbabwe, Mozambique and Angola.

The Southern White Rhino was hunted almost to extinction (1800's) with less than 30 individuals remaining at the turn of the Century. Conservation efforts in South Africa, and more recently in other African countries, have now seen the wild population recover to a current estimated number of 5,560 individuals. (Per. Comm. Brooks 1992). Current estimates put the number under captive management at 570. (IZY and ISIS).

The wild population is increasing at approximately 5.2% pa calculated between 1987 and 1991 (Per. Comm. Brooks 1992), however the recent escalation in poaching has now turned from the Black Rhino to the White Rhino and this is seen as placing a major threat on the continued expansion or even maintenance of the current population levels.

With 90% of the worlds White Rhino located in South Africa, the future political and economic stability of this country must have an impact on the future of the species.

1.4 CONSERVATION MEASURES

Considerable work has been done with this species to re-introduce it to parts of its former range as the population in Natal expanded to permit relocation. These attempts at establishing new populations have met with mixed results, with most failures being as a result of poaching activities. Currently the only viable population existing outside South Africa is approximately 100 animals in the Hwange National Park, Zimbabwe.

A sizable captive population has been established, mainly from wild caught stock ex Natal and the species is now well established in zoos throughout the world.

A Rhino Global Captive Action Plan (GCAP) Workshop was held at London Zoo in May 1992 with the resulting conservation recommendatins.

1. To protect the species in-situ, particularly the core populations in Southern Africa.

2. To support the species ex-situ through Captive Management Programmes.

3. To develop genetic resource banking technology for African Rhinos.

4. To support anti-poaching efforts.

1.5 GENERAL BIOLOGY

The White Rhino is the only rhinoceros species regarded as a true grazer. It has a comparatively wide mouth together with tough leathery lips, and is the largest of all rhino species reaching a height of 2m and weights in excess of 2,000 kg. It also carried the longest horn of any species, which can be up to 150cms long. The life expectancy is from 45 to 50 years.

Adult breeding males set up well-defined territories which they defend vigorously, while females and calves move between several male territories in small family groups. Sub-adult males form small bachelor groups and move between territories, avoiding the resident breeding bull. In comparison to the Black Rhino behaviour, the White rhino is regarded as a very docile and placid species.

Breeding appears to occur throughout the year in South Africa with births occurring in almost any month. Females become sexually mature at between 4 and 5 years of age, with males at 5 - 6 years of age. Females are reported to come into oestrous approximately every 30 days, which lasts for 1 - 2 days, and if successfully mated have a gestation period lasting approximately 496 days (main range 480 - 510 days). It appears that a post-partus oestrous 30 days following birth does occur and a number of zoos have reported inter-calf intervals at 554 days.

1.6 HOUSING IN CAPTIVITY

White Rhino are normally very quiet animals to handle under captive management conditions, although due to their huge size and strength, require solid construction for night-yarding etc. They are considered to be a hardy species and can be kept quite successfully in temperate climates providing protection is given from wind and rain. During period of hot, dry temperatures shade should be available as well as the provision of a mud wallow.

They are best suited to open range conditions, and given adequate space, (2ha plus) they will play little attention to surrounding boundary barriers. A number of zoos use post and steel cable although this can lead to horn rubbing. Electric fencing is very successful, particularly if used in conjunction with earth banks or vegetation barriers. Water moats can be used if they are over one metre deep, but White Rhino will paddle in shallow water.

1.7 MANAGEMENT OF CAPTIVE BREEDING GROUPS

The White Rhino have very specific requirements to encourage breeding and are best suited to small groups rather than pairs. Although breeding has occurred in pairs, the most successful results are achieved with multiple females, with the option of using more than one breeding male.

Behaviour stimulation (created by females moving through the male's territory) plays a significant part in successful White Rhino breeding and under captive management this must be carefully considered. Rhino raised together as siblings frequently don't breed and even in small groups breeding is sometimes infrequent.

Principles in stimulating breeding behaviour in captive White Rhino populations are as follows:

(A) Introductions of new breeding males to female groups or rotating breeding males.

(B) The presence of more than one female in the group seems to stimulate the other females.

Care must be taken with newborn offspring, particularly with jealous and aggressive territorial males. Male offspring must be removed at an early age, e.g. under 18 months for they are not tolerated by the territorial male.

The White Rhino has proved to be a reasonably tolerant species when displayed with other African hoofstock, and there are a number of compatible mixed displays in zoos which include zebras, ostrich, etc. However, caution should be considered in mixing with any aggressive large horned antelope.

1.8 HISTORY OF CAPTIVE POPULATION

During the early 70's a number of major transfers occurred from the Umfolozi Game Reserve in South Africa, with a large number of White Rhino going to North American and European Zoos. Whipsnade Zoo, England, and the San Diego Wild Animal Park, U.S.A. have both maintained large breeding groups for a number of years, with San Diego now recording over 70 live births.

The first importations of Southern White Rhino into the Australasian region occurred in the early 1980's, with the Western Plains Zoo importing a group from England (Whipsnade including wild born stock ex Umfolozi). The Auckland Zoo imported a pair born at the San Diego Wild Animal Park, USA (Sept. 1980). The Werribee Zoological Park imported a pair from Whipsnade Zoo, England (Sept. 1981) and the Wellington Zoo/Orana Park importation of 1.2 born at the San Diego Wild Animal Park USA (April 1986).

Only the Western Plains Zoo has recorded any breeding with two young successfully being raised to date.

1.9 HISTORY OF SPECIES MANAGEMENT PLAN (SMP)

A stud-book was established under the Guide-lines of the Association of Zoo Directors of Australia and New Zealand (AZDANZ) IN 1986 and this later developed into a full SMP co-ordinated by Paul Garland with the last full review being printed in January 1990.

Highlights of Actions Adopted During Original SMP

A. Stumpy - The transfer of male "Stumpy" from the Western Plains Zoo to Orana Park for breeding over the two San Diego born females (Nov. 1989)

B. Likwezi - The transfer of the female Likwezi from the Western Plains Zoo to Werribee Zoological Park to breed with male "Lee" (this is to ensure that she does not breed back to her father "Thomas")

C. Alexandra - The transfer of the female "Alexandra" from Werribee Zoological Park to Western Plains Zoo to breed with wild born male "Thomas". (This is to ensure she does not breed with her sibling brother "Lee").

D. New Males - The importation of three new SSP males from North America being "Memphis", "Cyrano" and "Star" who arrived early 1989.

NB : A young female was also imported from San Diego Wild Animal Park but has since died.

2. SPECIES MANAGEMENT PLAN

2.1 AIMS OF SPECIES MANAGEMENT PLAN

The primary aims of the Species Management Plan are as follows:

A. To establish a captive breeding population of Southern White Rhino within Australasia, as part of the Global Captive Action Plan (GCAP) for Rhino.

B. To manage this population effectively and maintain genetic diversity.

C. To work closely with other regional species management groups to contribute to the international conservation of the species. Both in-situ and ex-situ.

The GCAP recommendations for the ASMP White Rhino population is to establish approximately 60 individuals (N) with an active breeding component of approximately 30 individuals (Ne). To achieve this a substantial importation of reproductive class animals will need to be undertaken in the next two to five years if the ASMP population is to reach this target level within the next 20 years. (See Capacity Report in appendices).

The SMP aims to maintain 90% of the heterozygosity over 100 years and to achieve this with the projected population levels we will need periodic transfers of new founder blood-lines from other zoo regions.

2.2 MANAGEMENT TEAM

Paul Garland Orana Park Wildlife Trust	SMP Co-ordinator
Joe Christman Orana Park Wildlife Trust	Data Analysis/Technical Adviser
Richard Jakob-hoff Auckland Zoological Park	Husbandry/Veterinary Adviser
Tom Foose International Rhino Foundation	Rhino GCAP Adviser

It is anticipated that through the formation of this SMP, liaison on an international level with both the IUCN African Rhino Specialist Group and the International Rhino Foundation will advance Global planning conservation requirements.

2.3. DEMOGRAPHIC AND GENETIC REVIEW OF ASMP POPULATION

A. Population Size and Structure

The current population (June 93) is 14 individual comprised of 8 males and 6 females. A complete stud-book and master plan for each participating institution in this programme is attached as Appendices.

B. Provenance

All but one individual in the ASMP population can be traced back to wild caught founders obtained from Natal, South Africa during the 1970's.

C. Regional Capacity

It is anticipated that sufficient accommodation is available for the next ten years, even if further importations take place. The Regional census and Plan (1993) shows the preferred listing for the six participating zoos to a total of 33 individuals (13.20). As this species can be held in a herd situation it is understood that additional holding capacity will be available particularly in the open range zoos.

Recommended space allocations:

Orana Park	2.4
Dubbo	4.4
Monarto	2.6
Tipperary	2.4
Wellington	2.0
Werribee	2.4
	14.22

NB : Additiional space is still required to reach population target of 60

D. Population Age Profile

With the exception of two individuals (T13 and T14) all of the ASMP population is under 15 years of age, therefore in general terms it is a relatively young population. All of the females are over seven years of age and must now be considered as reproductively eligible. While three of the males are six years or younger and are unlikely to yet be reproductively active.

(SPARKS Age Pyramid reports are attached in the appendix.)

2.4 GENETIC REVIEW OF ASMP POPULATION

A. Founder Representation

Genetic Summary

	LIVING DESCENDANT POPULATION POTENTIAL			
	With Unknowns	Without	With Unknowns	Without
Number of Founders:	18	17	19	18
Mean Retention:	0.554	0.557	0.591	0.596
Founder Genomes Surviving:	9.963	9.463	11.220	10.720
Founder Genome Equivalents	8.003	7.560	11.220	10.720
Fraction of Wild Gene Diversity Retained:	0.938	0.934	0.955	0.953
Fraction of Wild Gene Diversity Lost:	0.062	0.066	0.045	0.047
Mean Inbreeding Coefficient:	0.000			

Of the animals imported to Dubbo from Whipsnade 1.1 (Thomas & Tessa) are founders of the world population because they are wild born and have progeny. Nicole, although wild born at Umfolozi also, is not a founder because she is sterile (she may be considered a potential founder if her sterility was thought to be reversible). Tessa has since died.

(SPARKS graph of founder representation is attached as appendix.)

B. Inbreeding

No inbreeding has yet occurred although we have a number of brother/sister relationships present and it is imperative that all of these are replaced with unrelated breeding partners. All of the current San Diego WAP born animals in Australasia have the same sire.

(SPARKS inbreeding co-efficient reports are attached with appendix.)

C. Gene Drop Analysis

(See attached report in appendices)

D. Test Matings

Top six possible mating have been trialed through GENES, report attached with appendix.

2.5 STRATEGY FOR MANAGEMENT OF ASMP POPULATION

(A) To bring all potential reproductive animals into breeding situation.

(B) To consolidate breeding group with the aim of establishing larger female herds at open range zoos to encourage breeding.

(C) Maintain/expand genetic diversity in the population by selective breeding.

(D) Maximise the use of wild born founders to increase their genetic representation in the world herd.

(E) Equalise the sex ratio of breeders by rotation of males in breeding groups to give all males a chance to breed.

(F) Import additional animals (females principally) of sound genetic background to establish viable breeding populations in ASMP region.

2.6 RECOMMENDED ACTION PLAN 1993/94

The future breeding strategy (as seen at present) relies heavily on the availability and importation of additional White Rhino individuals. Currently only the Western Plains Zoo and Orana Park Wildlife Trust have sufficient animals to constitute breeding groups. Every effort must be made to bring all animals in the population into breeding situations.

A. Auckland Zoo Female

It is important to consider the transfer of the female "SAW43" from the Auckland Zoo to Orana Park to breed with male "Stumpy" and/or "Cyrano".

B. Short Term Loans

The present short term breeding loans of "Likwezi" to Werribee and "Alexandra" to Western Plains Zoo should become long term to avoid inbreeding.

C. Importation

It is imperative that we advance the importation of up to six reproductively capable females to boost the population in the following participating institutions:

- Western Plains Zoo	2 Females
- Werribee Zoological Park	2 Females
- Tipperary Sanctuary	2 Females
	6 Females

3. REFERENCES

International Stud-book for African Rhinoceroses 1991 - published by Berlin Zoological Gardens Stud-book Keeper, Professor Dr. Dr. h. c. Heinz-Georg Klos.

Rhino Global Captive Action Plan - published July 1992 following a CBSG Rhino Strategy Workshop held in London, May 1992.

International Zoo Year-book (IZY) - Published annually by London Zoological Society UK.

International Species Information system (ISIS) - The international database for zoos operating out of Minnesota, USA.

Ryder O V : AAZPA Report 1986 - (San Diego Zoological Society)

Brook M : (African Rhino Specialist Group) Personal Comments During Rhino GCAP Workshop - London Zoo May 1992

APPENDICES

1. SPARKS Data Analysis Reports
   - Assumptions and Additions
   - Institution Masterplan Reports
   - White Rhino Stud-book
   - Inbreeding coefficient Report
   - Census Report and Graph
   - Founder Representation Graph
   - Founder Analysis
   - Gene Drop Analysis
   - Founder Allele Representation
   - Inbreeding and Kinship
   - Mating Choices
   - Age Pyramid reports
   - Fecundity and Mortality Reports
   - Capacity Review

2. Rhino Global Captive Action Plan (GCAP)

3. Map of White Rhino Distribution (Past and Present)

SPARKS DATA ANALYSIS

ASSUMPTIONS

1. All dates of 01 - 01 - are an assumed date, and need to be researched and replaced with the real date.

2. Death dates of 31-012- are assumed to be incorrect and should be researched.

3. Birth locations of wild born animals should be researched. Umfolozi has been used as a default for wild born stock.

ADDITIONS NEEDED

- International stud-book numbers are not listed in this stud-book - they should be cross referenced and added.

- One unknown whipsnade pair should be further researched - only ones in the group

- All transfers should be double checked and updated.

- All medical data, ear tags, etc., should be checked and updated.

Living Population at: Western Plains Zoo DUBBO

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 Sibs Live Offsp Repro Offs
T13	M	31 Dec 1968	WILD	D00180	1.0000	.0000	.	.	.2565	0.490	. .
		6 May 1980	WILD			.0000	.0435	.0460	.0000		1. 1. 0
											. .
T14	F	31 Dec 1968	WILD	D00280	1.0000	.0000	.	.	1.000	0.590	. .
		6 May 1980	WILD			.0000	.0000	.0000	.0000		. .
											. .
T31	F	21 Dec 1985	T13	D00185	1.0000	.0000	.	.	.5000	1.860	1. 0. 0
T18=50% T13=50%											
		21 Dec 1985	T18			.0000	.0543	.0558	.7435		. .
											. .

<< G l o b a l >>

Masterplan Report
SOUTHERN WHITE RHINO Studbook age 1
(Ceratotherium simum simum)

Living Population at: Werribee Zoological Park WERRIBEE

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 Sibs / Live Offsp / Repro Offspr
		Founder Representation									
T23	M	21 Sep 1980	T11	R00181	1.0000	.0000	.	.	.7515	2.030	0. 1. 0
		17 Sep 1981	T1			.0000	.0543	.0563	.7515		. .
		T1=50% T11=50%									. .
T24	F	6 Nov 1980	T11	R00281	1.0000	.0000	.	.	.7515	1.470	1. 0. 0
		17 Sep 1981	T12			.0000	.0543	.0464	.7515		. .
		T12=50% T11=50%									. .

Masterplan Report
SOUTHERN WHITE RHINO Studbook age 1
(Ceratotherium simum simum)

Living Population at: Perth Zoological Gardens PERTH

Stud # / Founder r / pr	Sex	Birth Date / Arrival / Representation	Sire / Dam	Loc ID / Social	Genome / Known	F / [unks = founders] / [unknowns removed]	MK	KV	GU-All / GU-CB	Vx	Global Live Sibs / Live Offsp / Repro Offs
T32	M	23 Oct 1987	T2	_____	1.0000	.0000	.	.	1.000	2.040	. .
T19=50% T2=50%		1 Jan 1990	T19			.0000	.0435	.0479	1.000		. .
											. .

Masterplan Report
SOUTHERN WHITE RHINO Studbook age 1
(Ceratotherium simum simum)

Living Population at: Auckland Zoological Park AUCKLAND

Stud # / Founder r / pr	Sex	Birth Date / Arrival / Representation	Sire / Dam	Loc ID / Social	Genome / Known	F / [unks = founders] / [unknowns removed]	MK	KV	GU-All / GU-CB	Vx	Global Live Sibs / Live Offsp / Repro Offs
T21	F	4 Apr 1979	T3	K00180	1.0000	.0000	.	.	.5290	1.350	2. 2.
0 T4=50% T3=50%		1 Jan 1981	T4			.0000	.0870	.0754	.5290		. .
											. .
T22	M	5 May 1979	T3	K00280	1.0000	.0000	.	.	.5335	1.840	1. 3.
0 T5=50% T3=50%		1 Jan 1981	T5			.0000	.0870	.0840	.5335		. .
											. .

Living Population at: Orana Park Wildlife Trust ORANA

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 Sibs / Live Offsp / Repro Offs
	Founder Representation										
T26	M	17 Jun 1983	T13	531	0.5000	.0000	.	.	.5000	2.060	0. 1.
0	T13=50%	24 Oct 1988	T20			.0000	.0435	.0460	.7435		. .
											. .
T27	F	8 Jul 1984	T3	280	1.0000	.0000	.	.	.5290	1.770	2. 2.
0	T6=50% T3=50%	17 May 1986	T6			.0000	.0870	.0827	.5290		. .
											. .
T28	F	29 Jul 1984	T3	279	1.0000	.0000	.	.	.5320	1.770	2. 2.
0	T7=50% T3=50%	17 May 1986	T7			.0000	.0870	.0827	.5320		. .
											. .
T35	M	23 Jan 1987	T16	609	1.0000	.0000	.	.	1.000	2.040	. .
	T17=50% T16=50%	3 Jan 1989	T17			.0000	.0435	.0479	1.000		. .
											. .

Masterplan Report Definitions
SOUTHERN WHITE RHINO Studbook
(Ceratotherium simum simum)

Stud # -- Studbook ID number
Sex -- '*' indicates the animal is sterilized or contracepted
Birth/Hatch Date
Arrival -- Arrival date at the curent institution
Sire/Dam -- Sire/Dam IDs
Loc ID -- Current institution ID number
Social -- Current social group at the current institution

Genome Known: Proportion of animal's genome known

F -- Inbreeding Coefficient
First value assumes animals of unknown origin are founders.
Second value omits animals of unknown origin.

MK -- mean kinship
First value is mean kinship. Second value is mean kinship if animals of unknown origin are omitted.

KV -- kinship value
A weighted mean kinship where the weights are the other animals' reproductive values. Second value omits animals of unknown origin.

GU-All -- Genome Uniqueness
Proportion of genes in an animal that are not found in the rest of the population.

GU-CB -- Genome Uniqueness of Captive-Born Animals
Proportion of genes in an animal that are not found in the rest of the captive-born population.

Vx -- Expected future lifetime reproduction by an animal of age x.

G L O B A L vs. Restricted -- Following values may be calculated using all animals in the studbook or using the population specified by the view set for the report.

Live sibs -- Half siblings are counted as complete siblings.
Live offspr -- Living offspring
Repro offspr -- Reproducing offspring

Founder representation -- Percent of this animal's genes that descended from each founder.

Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Event	Birth-Ori
Origin	Country	Death-Date	Removal Date	Name					
T1	F	31 Dec 1955	WILD	WILD	NATAL SA	31 Dec 1955	UNK	Capture	Wild Born
	S.AFRICAR		5 Aug 1970	WHI 21					
					WHIPSNADE	5 Aug 1970	UNK	Transfer	
	ENGLAND		15 Dec 1986						
						15 Dec 1986		Death	
		15 Dec 1986							
T2	M	31 Dec 1961	WILD	WILD	UMFOLOZI	31 Dec 1961	UNK	Capture	Wild Born
	S.AFRICAR		15 Sep 1964	MEM 01					
					MEMPHIS	15 Sep 1964	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T3	M	31 Dec 1960	WILD	WILD	UMFOLOZI	31 Dec 1960	UNK	Capture	Wild Born
	S.AFRICAR		31 Mar 1984	MANDHLA					
					SANDIEGOZ	8 Sep 1962	UNK	Transfer	
	U.S.A.		11 May 1971						
					SD-WAP	11 May 1971	UNK	Transfer	
	U.S.A.		27 Oct 1983						
					FERNDALE	19 Nov 1983	UNK	Transfer	
	U.S.A.		31 Mar 1984						
						31 Mar 1984		Death	
		31 Mar 1984							
T4	F	31 Dec 1963	WILD	WILD	UMFOLOZI	31 Dec 1963	UNK	Capture	Wild Born
	S.AFRICAR		1 Jan 1993	SAW 09					
					SD-WAP	17 Feb 1971	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T5	F	31 Dec 1963	WILD	WILD	UMFOLOZI	31 Dec 1963	UNK	Capture	Wild Born
	S.AFRICAR		17 Feb 1971	SAW 13					
					SD-WAP	17 Feb 1971	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T6	F	31 Dec 1963	WILD	WILD	UMFOLOZI	31 Dec 1963	UNK	Capture	Wild Born
	S.AFRICAR		17 Feb 1971	UMFOLOZI					
					SD-WAP	17 Feb 1971	SAW 18	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T7	F	31 Dec 1963	WILD	WILD	UMFOLOZI	31 Dec 1963	UNK	Capture	Wild Born
	S.AFRICAR		1 Jan 1993	MACITE					
					SD-WAP	17 Feb 1971	SAW 06	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T8	F	31 Dec 1963	WILD	WILD	NATAL SA	31 Dec 1963	UNK	Capture	Wild Born

	U.S.A.		1 Jan 1993			1 Jan 1993		Death	
		1 Jan 1993							
T9	F	31 Dec 1965	WILD	WILD	UMFOLOZI	31 Dec 1965	UNK	Capture	Wild Born
	S.AFRICAR		5 Aug 1970 STA 02						
					SAN ANTON	5 Aug 1970	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T10	M	31 Dec 1965	WILD	WILD	UMFOLOZI	31 Dec 1965	UNK	Capture	Wild Born
	S.AFRICAR		5 Aug 1970 STA 01						
					SAN ANTON	5 Aug 1970	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T11	M	31 Dec 1966	WILD	WILD	UMFOLOZI	31 Dec 1966	UNK	Capture	Wild Born
	S.AFRICAR		23 Jun 1967 WHI 01						
					WHIPSNADE	23 Jun 1967	UNK	Transfer	
	ENGLAND		1 Jun 1985						
					MOSCOW	1 Jun 1985	UNK	Transfer	
	USSR		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T12	F	31 Dec 1967	WILD	WILD	NATAL SA	31 Dec 1967	UNK	Capture	Wild Born
	S.AFRICAR		5 Aug 1970 WHI 17						
					WHIPSNADE	5 Aug 1970	UNK	Transfer	
	ENGLAND		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2
Data current thru: 0 •ba 0 AUSTRALASIAN ZOOS 27
Jun 1993

Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Event	Birth-Origin
	Country	Death-Date	Removal Date	Name					
T13	M	31 Dec 1968	WILD	WILD	UMFOLOZI	31 Dec 1968	UNK	Capture	Wild Born
	S.AFRICAR		31 Dec 1970	THOMAS					
					WOBURNLTD	31 Dec 1970	UNK	Transfer	
	ENGLAND		6 May 1980						
					DUBBO	6 May 1980	D00180	Transfer	
	AUST	AUST							
T14	F	31 Dec 1968	WILD	WILD	UMFOLOZI	31 Dec 1968	UNK	Capture	Wild Born
	S.AFRICAR		31 Dec 1970	NICOLE					
					WOBURNLTD	31 Dec 1970	UNK	Transfer	
	ENGLAND		6 May 1980						
					DUBBO	6 May 1980	D00280	Transfer	
	AUST	AUST							
T15	M	31 Dec 1968	WILD	WILD	AFRICAN	31 Dec 1968	UNK	Capture	Wild Born
	AFRICAN		31 Dec 1971	IAE 20					
					FERNDALE	31 Dec 1971	UNK	Transfer	
	U.S.A.		27 Oct 1983						
					SD-WAP	27 Oct 1983	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T16	M	31 Dec 1969	WILD	WILD	NATAL SA	31 Dec 1969	UNK	Capture	Wild Born
	S.AFRICAR		31 Dec 1975	JAX 03					
					JACKSONVL	31 Dec 1975	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T17	F	31 Dec 1969	WILD	WILD	NATAL SA	31 Dec 1969	UNK	Capture	Wild Born
	S.AFRICAR		3 Jan 1990	JAX 04					
					JACKSONVL	1 Jan 1975	UNK	Transfer	
	U.S.A.		1 Jan 1993						
						1 Jan 1993		Death	
		1 Jan 1993							
T18	F	31 Dec 1969	WILD	WILD	UMFOLOZI	31 Dec 1969	UNK	Capture	Wild Born
	S.AFRICAR		6 May 1980	TESSA					
					DUBBO	6 May 1980	S00180	Transfer	
	AUST	AUST	4 Nov 1988						
						4 Nov 1988		Death	
		4 Nov 1988							
T19	F	31 Dec 1972	WILD	WILD	AFRICAN	31 Dec 1972	UNK	Capture	Wild Born
	AFRICAN		2 Oct 1973	MEM 03					
					DOSWELL	2 Oct 1973	UNK	Transfer	

	U.S.A.		16 Apr 1976		MEMPHIS	16 Apr 1976	UNK	Transfer		
	U.S.A.		1 Jan 1993			1 Jan 1993		Death		
		1 Jan 1993								
T20	F	23 Oct 1976	UNK	UNK	WHIPSNADE	23 Oct 1976	UNK	Birth	Captive B	
brn	ENGLAND		17 Sep 1981	NANDI						
					SYDNEY	17 Sep 1981	UNK	Transfer		
	AUST AUST		26 Nov 1981							
					DUBBO	26 Nov 1981	S00181	Transfer		
	AUST AUST		26 Jan 1984							
						26 Jan 1984		Death		
		26 Jan 1984								
T21	F	4 Apr 1979	T3	T4	SD-WAP	4 Apr 1979	UNK	Birth	Captive B	
brn	U.S.A.		6 Sep 1980	SESHEKA						
					ORANA	6 Sep 1980	UNK	Transfer		
	NZ NZ		1 Jan 1981							
					AUCKLAND	1 Jan 1981	K00180	Transfer		
	NZ NZ									
T22	M	5 May 1979	T3	T5	SD-WAP	5 May 1979	UNK	Birth	Captive B	
brn	U.S.A.		6 Sep 1980	MANDHLA						
					ORANA	6 Sep 1980	UNK	Transfer		
	NZ NZ		1 Jan 1981							
					AUCKLAND	1 Jan 1981	K00280	Transfer		
	NZ NZ									
T23	M	21 Sep 1980	T11	T1	WHIPSNADE	21 Sep 1980	UNK	Birth	Captive B	
brn	ENGLAND		17 Sep 1981	LEE						
					WERRIBEE	17 Sep 1981	R00181	Transfer		
	AUST AUST									
T24	F	6 Nov 1980	T11	T12	WHIPSNADE	6 Nov 1980	UNK	Birth	Captive B	
brn	ENGLAND		17 Sep 1981	ALEXANDRA						
					WERRIBEE	17 Sep 1981	R00281	Transfer		
	AUST AUST									
T25	F	18 May 1981	T13	T18	DUBBO	18 May 1981	D00181	Birth	Captive B	
brn	AUST AUST		20 May 1981	SAG						
						20 May 1981		Death		
		20 May 1981								

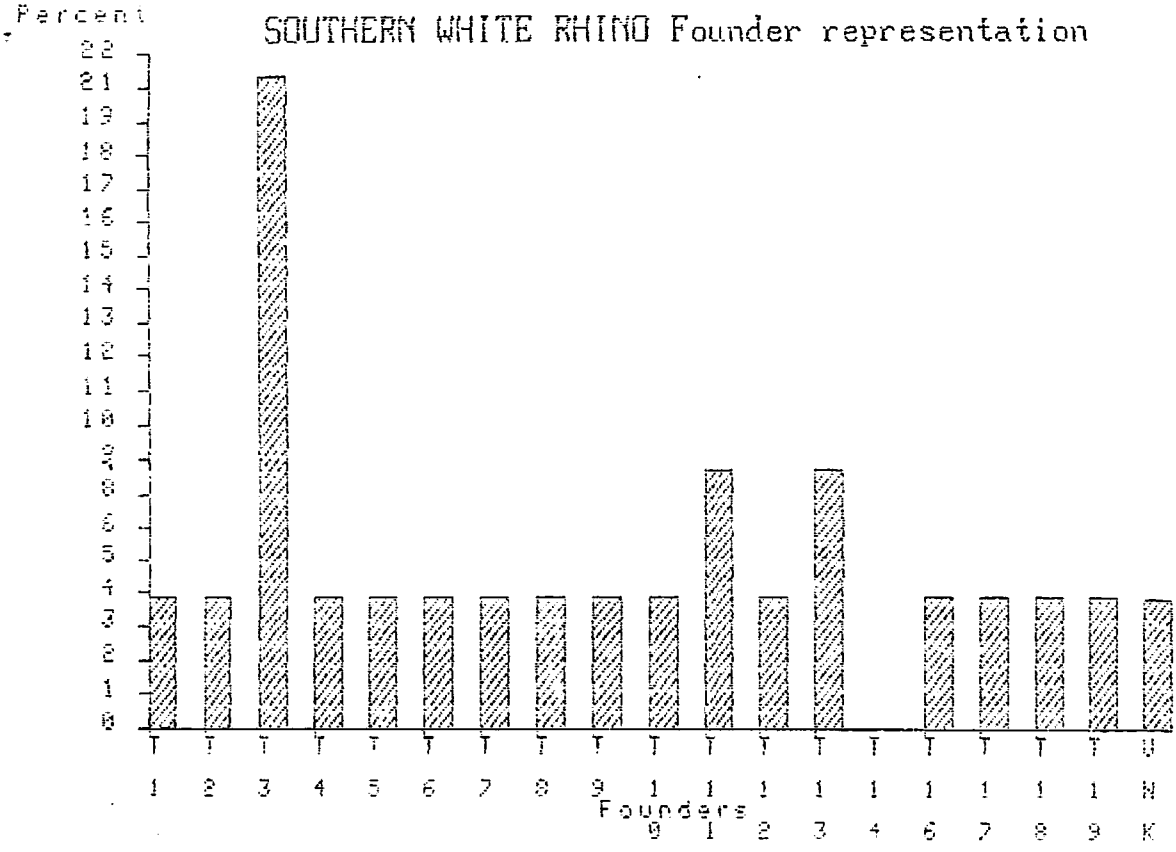
Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Event	Birth-Origin	Country	Death-Date	Removal Date	Name
T26	M	17 Jun 1983	T13	T20	DUBBO	17 Jun 1983	D00183	Birth	Captive Born	AUST	AUST		
						24 Oct 1988							STUMPY
					ORANA	24 Oct 1988	531	Loan to		NZ	NZ		
T27	F	8 Jul 1984	T3	T6	SD-WAP	8 Jul 1984	UNK	Birth	Captive Born	U.S.A.			
						25 Apr 1986							UTANI
					ORANA	17 May 1986	280	Transfer		NZ	NZ		
T28	F	29 Jul 1984	T3	T7	SD-WAP	29 Jul 1984	UNK	Birth	Captive Born	U.S.A.			
						25 Apr 1986							MAPENZI
					ORANA	17 May 1986	279	Transfer		NZ	NZ		
T29	M	6 Dec 1984	T3	T8	SD-WAP	6 Dec 1984	UNK	Birth	Captive Born	U.S.A.			
						17 May 1986							NAKILI
					ORANA	17 May 1986	281	Transfer		NZ	NZ		
						1 Jan 1990							
					TIPP.STAT	1 Jan 1990	UNK	Transfer		AUST	AUST		
T30	M	21 May 1984	T13	T18	DUBBO	21 May 1984	D00184	Birth	Captive Born	AUST	AUST		
						18 Aug 1984							NKULU
						18 Aug 1984		Death				18 Aug 1984	
T31	F	21 Dec 1985	T13	T18	DUBBO	21 Dec 1985	D00185	Birth	Captive Born	AUST	AUST		
							LIKWEZI						
T32	M	23 Oct 1987	T2	T19	MEMPHIS	23 Oct 1987	UNK	Birth	Captive Born	U.S.A.			
						3 Jan 1989							MEMPHIS
					ORANA	3 Jan 1989	UNK	Transfer		NZ	NZ		
						1 Jan 1990							
					PERTH	1 Jan 1990	UNK	Transfer		AUST	AUST		
T33	M	30 Jun 1987	T10	T9	SAN ANTON	30 Jun 1987	UNK	Birth	Captive Born	U.S.A.			
						3 Jan 1989							STAR

						ORANA	3 Jan 1989	C00390	Transfer		
	NZ NZ			1 Jan 1990							
						TIPP.STAT	1 Jan 1990	UNK	Transfer		
	AUST AUST										
T34	F	2 Nov 1988	T13	T18	DUBBO		2 Nov 1988	D00188	Birth	Captive B	
orn	AUST AUST			2 Nov 1988 D188							
							2 Nov 1988		Death		
		2 Nov 1988									
T35	M	23 Jan 1987	T16	T17	JACKSONVL		23 Jan 1987	UNK	Birth	Captive B	
orn	U.S.A.			3 Jan 1989 CYRANO							
						ORANA	3 Jan 1989	609	Transfer		
	NZ NZ										
T36	F	13 Nov 1988	T15	T5	SD-WAP		13 Nov 1988	UNK	Birth	Unk Birth	
Type	U.S.A.			3 Jan 1989 MWIVI							
						ORANA	3 Jan 1989	UNK	Transfer		
	NZ NZ			1 Jan 1990							
						PERTH	1 Jan 1990	UNK	Transfer		
	AUST AUST			1 Jan 1991							
							1 Jan 1991		Death		
		1 Jan 1991									

==========

TOTALS: 15.21.0 (36)

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2


SOUTHERN WHITE RHINO Founder representation
Percent
22
21
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T16
T17
T18
T19
UNK
Founders

Inbreeding Coefficient Report
SOUTHERN WHITE RHINO Studbook

Taxon Name: CERATOTHERIUM SIMUM SIMUM

Stud #	Sex	Age	Sire	Dam	Location	Death Date	Inbreeding
T1	Female	30Y,11M,22D	WILD	WILD	WHIPSNADE	15 Dec 1986	0
T3	Male	23Y,3M,5D	WILD	WILD	FERNDALE	31 Mar 1984	0
T2	Male	31Y,0M,9D	WILD	WILD	MEMPHIS	1 Jan 1993	0
T4	Female	29Y,0M,9D	WILD	WILD	SD-WAP	1 Jan 1993	0
T5	Female	29Y,0M,9D	WILD	WILD	SD-WAP	1 Jan 1993	0
T6	Female	29Y,0M,9D	WILD	WILD	SD-WAP	1 Jan 1993	0
T7	Female	29Y,0M,9D	WILD	WILD	SD-WAP	1 Jan 1993	0
T8	Female	29Y,0M,9D	WILD	WILD	SD-WAP	1 Jan 1993	0
T9	Female	27Y,0M,8D	WILD	WILD	SAN ANTON	1 Jan 1993	0
T10	Male	27Y,0M,8D	WILD	WILD	SAN ANTON	1 Jan 1993	0
T11	Male	26Y,0M,8D	WILD	WILD	MOSCOW	1 Jan 1993	0
T12	Female	25Y,0M,8D	WILD	WILD	WHIPSNADE	1 Jan 1993	0
T13	Male	24Y,6M,20D	WILD	WILD	DUBBO		0
T14	Female	24Y,6M,20D	WILD	WILD	DUBBO		0
T15	Male	24Y,0M,7D	WILD	WILD	SD-WAP	1 Jan 1993	0
T16	Male	23Y,0M,7D	WILD	WILD	JACKSONVL	1 Jan 1993	0
T17	Female	23Y,0M,7D	WILD	WILD	JACKSONVL	1 Jan 1993	0
T18	Female	18Y,10M,9D	WILD	WILD	DUBBO	4 Nov 1988	0
T19	Female	20Y,0M,6D	WILD	WILD	MEMPHIS	1 Jan 1993	0
T20	Female	7Y,3M,5D	??	??	DUBBO	26 Jan 1984	0
T21	Female	14Y,3M,15D	T3	T4	AUCKLAND		0
T22	Male	14Y,2M,14D	T3	T5	AUCKLAND		0
T23	Male	12Y,9M,26D	T11	T1	WERRIBEE		0
T24	Female	12Y,8M,11D	T11	T12	WERRIBEE		0
T25	Female	2D	T13	T18	DUBBO	20 May 1981	0
T26	Male	10Y,1M,1D	T13	T20	ORANA		0
T30	Male	2M,28D	T13	T18	DUBBO	18 Aug 1984	0
T27	Female	9Y,0M,9D	T3	T6	ORANA		0
T28	Female	8Y,11M,18D	T3	T7	ORANA		0
T29	Male	8Y,7M,10D	T3	T8	TIPP.STAT		0
T31	Female	7Y,6M,26D	T13	T18	DUBBO		0
T35	Male	6Y,5M,23D	T16	T17	ORANA		0
T33	Male	6Y,0M,17D	T10	T9	TIPP.STAT		0
T32	Male	5Y,8M,24D	T2	T19	PERTH		0
T34	Female	0D	T13	T18	DUBBO	2 Nov 1988	0
T36	Female	2Y,1M,19D	T15	T5	PERTH	1 Jan 1991	0

Specimens listed in birth date order.
2 Unknown parents treated as founders.
Parent IDs shown as ?'s are unknown and therefore treated as founders.

For specimens known to share unidentified parents (i.e. littermates) you may improve the calculations by entering some common identifier for each of them using the special data option: Parents Elsewhere. Example: 'SIRE4' and 'DAM15'.

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2
Data current thru: 1 Jun 1993 AUSTRALASIAN ZOOS
Jul 1993

Census Report

Restricted to: SOUTHERN WHITE RHINO Studbook

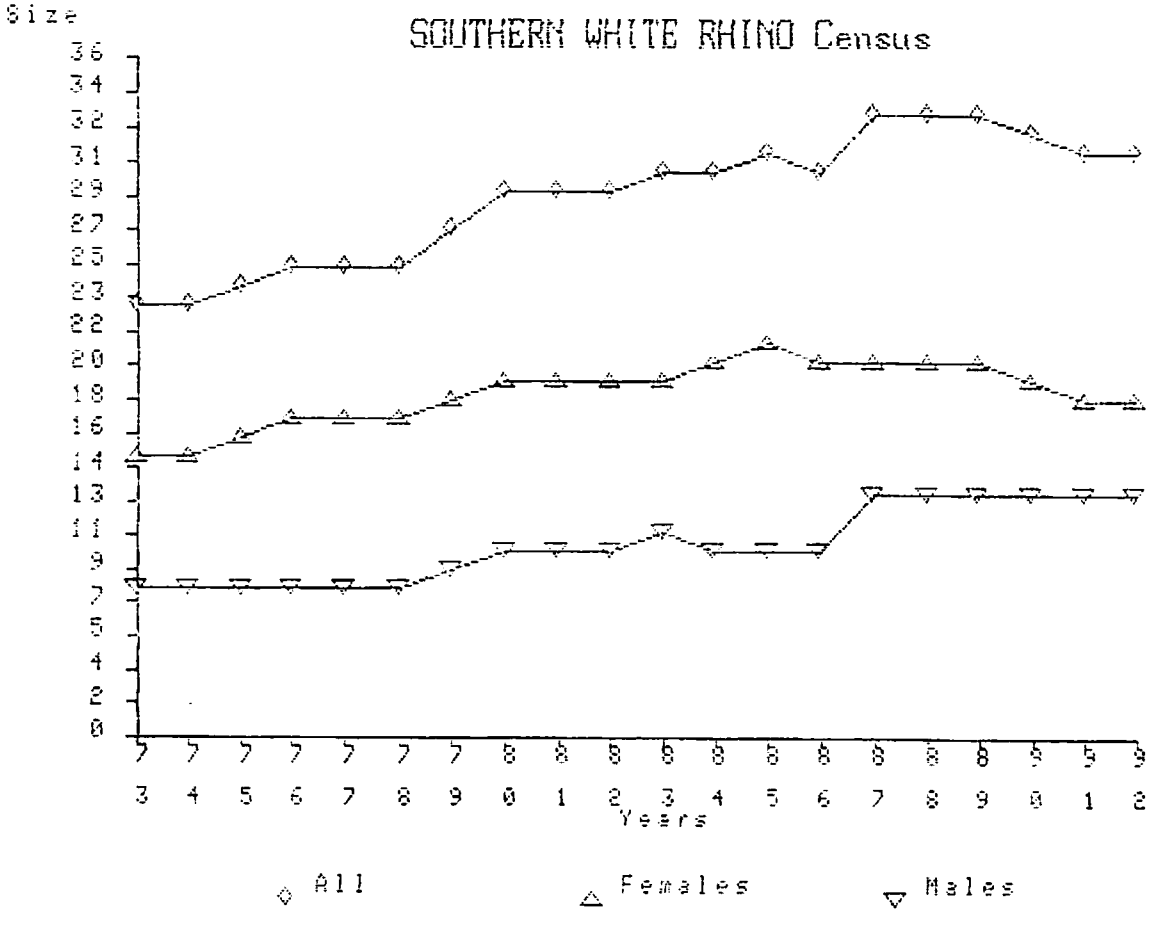
Dates: As of End of date <= 31/12/1992

Taxon Name: CERATOTHERIUM SIMUM SIMUM

Year as of 31 Dec	Specimen Counts		Observed Lambda Annual	Geometric Mean
1992	13.18.0	(31)	1.00	
1991	13.18.0	(31)	0.97	0.98 (last 2 yrs)
1990	13.19.0	(32)	0.97	0.98 (last 3 yrs)
1989	13.20.0	(33)	1.00	0.98 (last 4 yrs)
1988	13.20.0	(33)	1.00	0.99 (last 5 yrs)
1987	13.20.0	(33)	1.10	1.01 (last 6 yrs)
1986	10.20.0	(30)	0.97	1.00 (last 7 yrs)
1985	10.21.0	(31)	1.03	1.00 (last 8 yrs)
1984	10.20.0	(30)	1.00	1.00 (last 9 yrs)
1983	11.19.0	(30)	1.03	1.01 (last 10 yrs)
1982	10.19.0	(29)	1.00	1.01 (last 11 yrs)
1981	10.19.0	(29)	1.00	1.01 (last 12 yrs)
1980	10.19.0	(29)	1.07	1.01 (last 13 yrs)
1979	9.18.0	(27)	1.08	1.02 (last 14 yrs)
1978	8.17.0	(25)	1.00	1.01 (last 15 yrs)
1977	8.17.0	(25)	1.00	1.01 (last 16 yrs)
1976	8.17.0	(25)	1.04	1.02 (last 17 yrs)
1975	8.16.0	(24)	1.04	1.02 (last 18 yrs)
1974	8.15.0	(23)	1.00	1.02 (last 19 yrs)
1973	8.15.0	(23)	1.00	1.02 (last 20 yrs)
1972	8.15.0	(23)	1.10	1.02 (last 21 yrs)
1971	8.13.0	(21)	1.11	1.02 (last 22 yrs)
1970	8.11.0	(19)	1.00	1.02 (last 23 yrs)
1969	8.11.0	(19)	1.19	1.03 (last 24 yrs)
1968	7.9.0	(16)	1.23	1.04 (last 25 yrs)
1967	5.8.0	(13)	1.08	1.04 (last 26 yrs)
1966	5.7.0	(12)	1.09	1.04 (last 27 yrs)
1965	4.7.0	(11)	1.22	1.05 (last 28 yrs)
1964	3.6.0	(9)	1.00	1.04 (last 29 yrs)
1963	3.6.0	(9)	2.25	1.07 (last 30 yrs)
1962	3.1.0	(4)	1.33	1.08 (last 31 yrs)
1961	2.1.0	(3)	1.50	1.09 (last 32 yrs)
1960	1.1.0	(2)	2.00	1.11 (last 33 yrs)
1959	0.1.0	(1)	1.00	1.11 (last 34 yrs)
1958	0.1.0	(1)	1.00	1.10 (last 35 yrs)
1957	0.1.0	(1)	1.00	1.10 (last 36 yrs)
1956	0.1.0	(1)	1.00	1.10 (last 37 yrs)
1955	0.1.0	(1)	1.00	1.09 (last 38 yrs)

Note: Lambda values include Imports and Exports...

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2
Data current thru: 1 Jun 1993 AUSTRALASIAN ZOOS
Jul 1993



FOUNDER analysis for
white_rh Sun Jun 27 14:50:54 1993

Founder representation in each living animal:
Founders listed across top, descendants down side.
Founder calculations omit UNKNOWNs.

Founders	T1	T2	T3	T4	T5	T6	T7
Founders	T8	T9	T10	T11	T12	T13	T14
Founders	T16	T17	T18	T19			
T21	0.0000	0.0000	0.5000	0.5000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T22	0.0000	0.0000	0.5000	0.0000	0.5000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T23	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.5000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.5000	0.5000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.5000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T27	0.0000	0.0000	0.5000	0.0000	0.0000	0.5000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T28	0.0000	0.0000	0.5000	0.0000	0.0000	0.0000	0.5000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T29	0.0000	0.0000	0.5000	0.0000	0.0000	0.0000	0.0000
	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T31	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.5000	0.0000
	0.0000	0.0000	0.5000	0.0000			
T32	0.0000	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.5000			
T33	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.5000	0.5000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000			
T35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.5000	0.5000	0.0000	0.0000			

Founders	T1	T2	T3	T4	T5	T6	T7
Founders	T8	T9	T10	T11	T12	T13	T14

Founders T16 T17 T18 T19

Founder contributions

0.5000	0.5000	2.5000	0.5000	0.5000	0.5000	0.5000
0.5000	0.5000	0.5000	1.0000	0.5000	1.0000	0.0000
0.5000	0.5000	0.5000	0.5000			

Founders T1 T2 T3 T4 T5 T6 T7
Founders T8 T9 T10 T11 T12 T13 T14
Founders T16 T17 T18 T19

Fractional contributions

0.0435	0.0435	0.2174	0.0435	0.0435	0.0435	0.0435
0.0435	0.0435	0.0435	0.0870	0.0435	0.0870	0.0000
0.0435	0.0435	0.0435	0.0435			

Founders T1 T2 T3 T4 T5 T6 T7
Founders T8 T9 T10 T11 T12 T13 T14
Founders T16 T17 T18 T19

Number of living descendants

1	1	5	1	1	1	1
1	1	1	2	1	2	0
1	1	1	1			

GENE DROP analysis for
white_rh Sun Jun 27 14:50:54 1993

Studbook	Sire	Dam	Status	Prop. genome unique among living desc.	all living
T13 M	WILD	WILD	F		0.2565
T14 F	WILD	WILD	F		1.0000
T21 F	T3	T4	A	0.5290	0.5290
T22 M	T3	T5	A	0.5335	0.5335
T23 M	T11	T1	A	0.7515	0.7515
T24 F	T11	T12	A	0.7515	0.7515
T26 M	T13	T20	A	0.7435	0.5000
T27 F	T3	T6	A	0.5290	0.5290
T28 F	T3	T7	A	0.5320	0.5320
T29 M	T3	T8	A	0.5265	0.5265
T31 F	T13	T18	A	0.7435	0.5000
T32 M	T2	T19	A	1.0000	1.0000
T33 M	T10	T9	A	1.0000	1.0000
T35 M	T16	T17	A	1.0000	1.0000

---

19 Founders 12 Living descendants 31 In analysis

FOUNDER ALLELE REPRESENTATION

Founder	Retention	%Representation with unk	%Representation w/o	Target with unk	Target w/o	Difference with unk	Difference w/o
T1 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T2 M	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T3 M	0.968	20.833	21.739	8.628	9.030	-12.205	-12.709
T4 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T5 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T6 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T7 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T8 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T9 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T10 M	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T11 M	0.751	8.333	8.696	6.698	7.011	-1.635	-1.685
T12 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T13 ML	0.744	8.333	8.696	8.913	9.329	0.580	0.633
T14 FL	0.000	0.000	0.000	8.913	9.329	8.913	9.329
T16 M	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T17 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T18 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T19 F	0.500	4.167	4.348	4.457	4.664	0.290	0.317
T20 F U	0.500	4.167	0.000	4.457	0.000	0.290	0.000

GENETIC SUMMARY	LIVING DESCENDANT POPULATION with unknowns	LIVING DESCENDANT POPULATION w/o	POTENTIAL w/ unkn	POTENTIAL w/o
Number of founders:	18	17	19	18
Mean retention:	0.554	0.557	0.591	0.596
Founder genomes surviving:	9.963	9.463	11.220	10.720
Founder Genome Equivalents:	8.003	7.560	11.220	10.720
Fraction of wild gene diversity retained:	0.938	0.934	0.955	0.953
Fraction of wild gene diversity lost:	0.062	0.066	0.045	0.047
Mean inbreeding coefficient:	0.000			

Inbreeding coefficients and mean kinships for
white_rh Sun Jun 27 14:50:54 1993

Inbreeding and kinship calculations omit genes from UNKNOWN ancestors.

MEAN KINSHIP OF LIVING ANIMALS TO LIVING NON-FOUNDERS

STUDBOOK	SIRE	DAM	INBREEDING	MEAN KINSHIP	KINSHIP VALUE	GENOME KNOWN
T13 M	WILD	WILD	F = 0.0000	mk = 0.0435	kv = 0.0460	1.0000
T14 F	WILD	WILD	F = 0.0000	mk = 0.0000	kv = 0.0000	1.0000
T21 F	T3	T4	F = 0.0000	mk = 0.0870	kv = 0.0754	1.0000
T22 M	T3	T5	F = 0.0000	mk = 0.0870	kv = 0.0840	1.0000
T23 M	T11	T1	F = 0.0000	mk = 0.0543	kv = 0.0563	1.0000
T24 F	T11	T12	F = 0.0000	mk = 0.0543	kv = 0.0464	1.0000
T26 M	T13	T20	F = 0.0000	mk = 0.0435	kv = 0.0460	0.5000
T27 F	T3	T6	F = 0.0000	mk = 0.0870	kv = 0.0827	1.0000
T28 F	T3	T7	F = 0.0000	mk = 0.0870	kv = 0.0827	1.0000
T29 M	T3	T8	F = 0.0000	mk = 0.0870	kv = 0.0879	1.0000
T31 F	T13	T18	F = 0.0000	mk = 0.0543	kv = 0.0558	1.0000
T32 M	T2	T19	F = 0.0000	mk = 0.0435	kv = 0.0479	1.0000
T33 M	T10	T9	F = 0.0000	mk = 0.0435	kv = 0.0479	1.0000
T35 M	T16	T17	F = 0.0000	mk = 0.0435	kv = 0.0479	1.0000

ORDERED LISTS OF MEAN KINSHIP BY SEX:

Rank	MALES	MK	Age	Known	FEMALES	MK	Age	Known
1	T13	0.0435	24	1.000	T14	0.0000	24	1.000
2	T26	0.0435	10	0.500	T24	0.0543	13	1.000
3	T35	0.0435	6	1.000	T31	0.0543	8	1.000
4	T33	0.0435	6	1.000	T21	0.0870	14	1.000
5	T32	0.0435	6	1.000	T27	0.0870	9	1.000
6	T23	0.0543	13	1.000	T28	0.0870	9	1.000
7	T22	0.0870	14	1.000				
8	T29	0.0870	9	1.000				

GENETIC SUMMARY OF POPULATION

Descendant population Mean Kinship:	0.0652
Gene Diversity:	0.9348
Founder Genome Equivalents:	7.6667
Desc. population mean Kinship Value:	0.0637
Gene Value:	0.9363

MATING CHOICES: Inbreeding coefficients for potential offspring.
Males across top, females down side.
Studbook numbers followed by U indicate partially unknown ancestry.

	T13	T22	T23	T26U	T29	T32	T33
T14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
T21	0.0000	0.1250	0.0000	0.0000	0.1250	0.0000	0.0000
T24	0.0000	0.0000	0.1250	0.0000	0.0000	0.0000	0.0000
T27	0.0000	0.1250	0.0000	0.0000	0.1250	0.0000	0.0000
T28	0.0000	0.1250	0.0000	0.0000	0.1250	0.0000	0.0000
T31	0.2500	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000

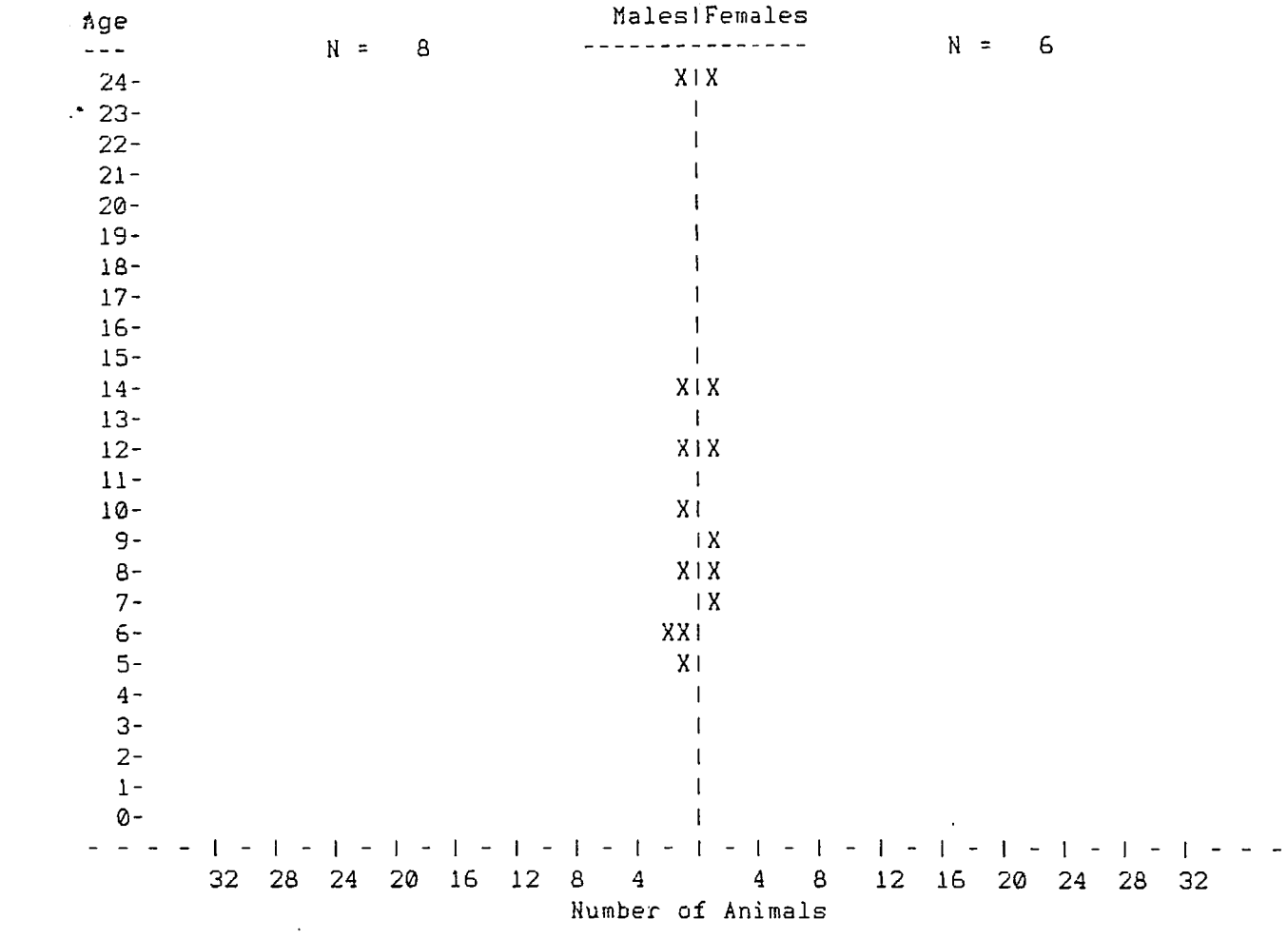
	T35
T14	0.0000
T21	0.0000
T24	0.0000
T27	0.0000
T28	0.0000
T31	0.0000

TOP 20 MATINGS CURRENT: GENE DIV=93.429% FGE= 7.609
Studbook numbers followed by U indicate partially unknown ancestry.

MALE	AGE	MK	FEMALE	AGE	MK	F	GENE DIV	FGE	PAIRS CHOSEN	F
T33	6	0.029	T14	24	0.014	0.000	93.755	8.0058	T13 x T14	0.000
T32	6	0.043	T24	13	0.054	0.000	93.481	7.6695	T35 x T21	0.000
T13	24	0.050	T31	8	0.057	0.250	93.389	7.5635	T35 x T27	0.000
T26U	10	0.050	T21	14	0.079	0.000	93.320	7.4846	T35 x T28	0.000
T23	13	0.054	T27	9	0.079	0.000	93.298	7.4605	T23 x T24	0.125
T22	14	0.068	T28	9	0.079	0.125	93.207	7.3602	T32 x T31	0.000
T29	9	0.068								
T35	6	0.071								

Age Pyramid Report
SOUTHERN WHITE RHINO Studbook

Taxon Name: CERATOTHERIUM SIMUM SIMUM



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

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2
Data current thru: 1 Jun 1993 AUSTRALASIAN ZOOS
Jul 1993

Age Pyramid Report — Report Date: 15 Jul 1993

SOUTHERN WHITE RHINO Studbook

Taxon Name: CERATOTHERIUM SIMUM SIMUM — Page 2

Age	Studbook Numbers >>> Male	
24	T13	
23		
22		
21		
20		
19		
18		
17		
16		
15		
14	T22	
13		
12	T23	
11		
10	T26	
9		
8	T29	
7		
6	T33	T35
5	T32	
4		
3		
2		
1		
0		

Total= 8

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust

Age Pyramid Report — Report Date: 15 Jul 1993
SOUTHERN WHITE RHINO Studbook

Taxon Name: CERATOTHERIUM SIMUM SIMUM — Page 3

Age	Studbook Numbers >>> Female
24	T14
23	
22	
21	
20	
19	
18	
17	
16	
15	
14	T21
13	
12	T24
11	
10	
9	T27
8	T28
7	T31
6	
5	
4	
3	
2	
1	
0	

Total= 6

Fecundity & Mortality Report
SOUTHERN WHITE RHINO Studbook

Taxon Name: CERATOTHERIUM SIMUM SIMUM

Age Class	Fecundity [Mx]... Male	N	Female	N	Mortality [Qx]... Male	N	Female	N
0- 1	0.00	14.2	0.00	19.0	0.06	15.5	0.09	22.1
1- 2	0.00	14.3	0.00	18.9	0.00	14.3	0.00	18.8
2- 3	0.00	15.0	0.00	18.1	0.00	13.3	0.06	17.4
3- 4	0.00	15.0	0.00	18.0	0.00	15.0	0.00	17.7
4- 5	0.00	15.0	0.00	18.0	0.00	14.4	0.00	16.5
5- 6	0.00	14.7	0.00	19.0	0.00	13.7	0.00	18.9
6- 7	0.00	12.5	0.03	19.0	0.00	12.5	0.00	19.0
7- 8	0.00	12.0	0.00	19.6	0.00	12.0	0.05	19.0
8- 9	0.00	11.6	0.00	19.1	0.00	11.6	0.00	19.1
9-10	0.00	11.0	0.00	18.0	0.00	11.0	0.00	18.0
10-11	0.00	10.1	0.00	18.0	0.00	9.7	0.00	17.7
11-12	0.00	10.0	0.03	18.0	0.00	10.0	0.00	18.0
12-13	0.05	9.8	0.03	17.7	0.00	9.8	0.00	17.7
13-14	0.11	9.0	0.00	17.0	0.00	9.0	0.00	17.0
14-15	0.06	8.2	0.06	16.3	0.00	7.4	0.00	15.7
15-16	0.06	8.0	0.09	16.0	0.00	8.0	0.00	16.0
16-17	0.06	8.0	0.00	16.0	0.00	8.0	0.00	16.0
17-18	0.06	8.0	0.03	16.0	0.00	8.0	0.00	16.0
18-19	0.13	8.0	0.03	15.9	0.00	7.6	0.07	15.0
19-20	0.13	8.0	0.00	15.0	0.00	8.0	0.00	15.0
20-21	0.00	8.0	0.12	13.0	0.00	8.0	0.08	13.0
21-22	0.06	8.0	0.04	13.0	0.00	8.0	0.00	13.0
22-23	0.00	7.9	0.00	13.0	0.00	7.1	0.00	13.0
23-24	0.27	5.5	0.00	12.0	0.40	5.0	0.08	12.0
24-25	0.00	3.5	0.09	11.5	0.28	3.5	0.00	11.5
25-26	0.17	3.0	0.00	10.0	0.00	3.0	0.10	10.0
26-27	0.00	2.0	0.00	10.0	0.50	2.0	0.00	10.0
27-28	0.00	1.0	0.00	9.0	1.00	1.0	0.11	9.0
28-29	0.00	1.0	0.00	9.0	0.00	1.0	0.00	9.0
29-30	0.00	1.0	0.00	1.0	0.00	1.0	1.00	1.0
30-31	0.00	1.0	0.00	1.0	0.00	1.0	0.00	0.0
31-32	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
32-33	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

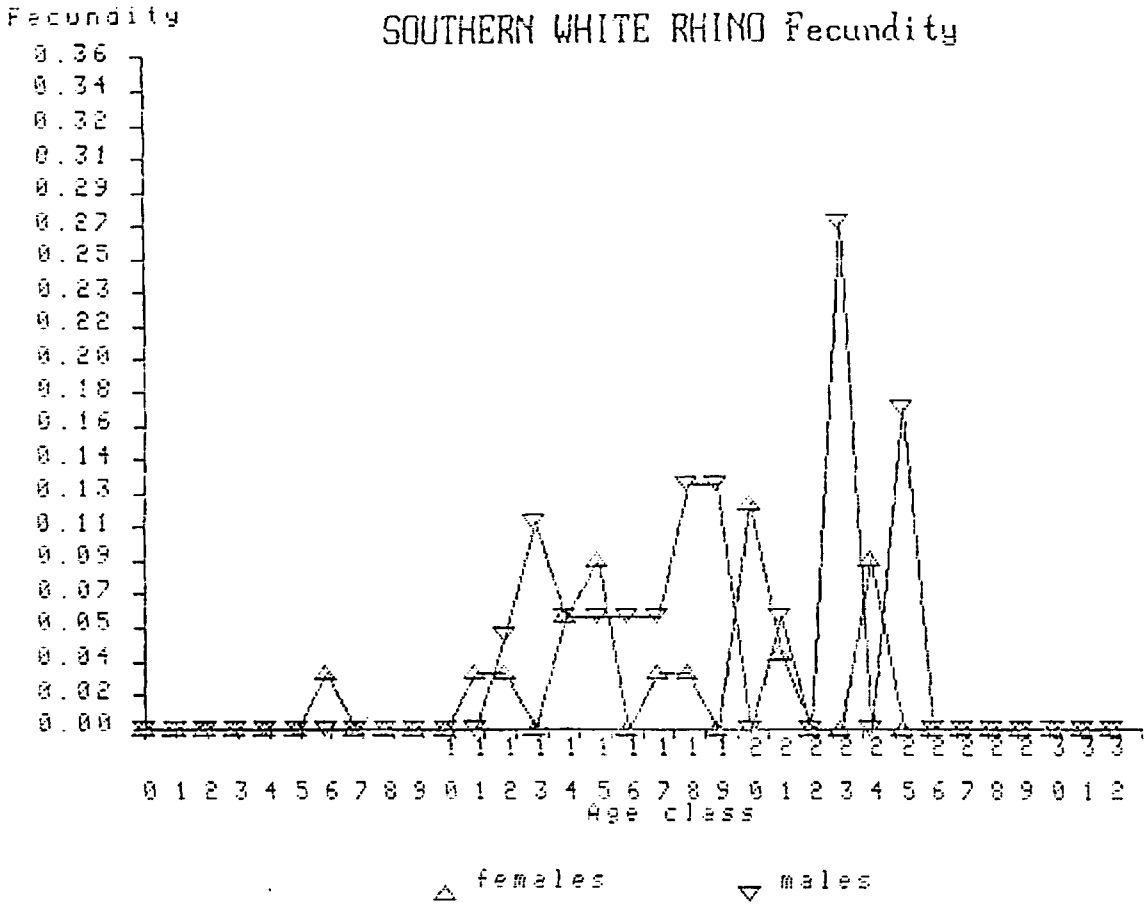
T = 18.193	T = 16.865	30 day mortality: 6%
Ro = 0.898	Ro = 0.412	(2 out of 36)
lambda=0.99	lambda=0.95	
r = -0.006	r = -0.053	

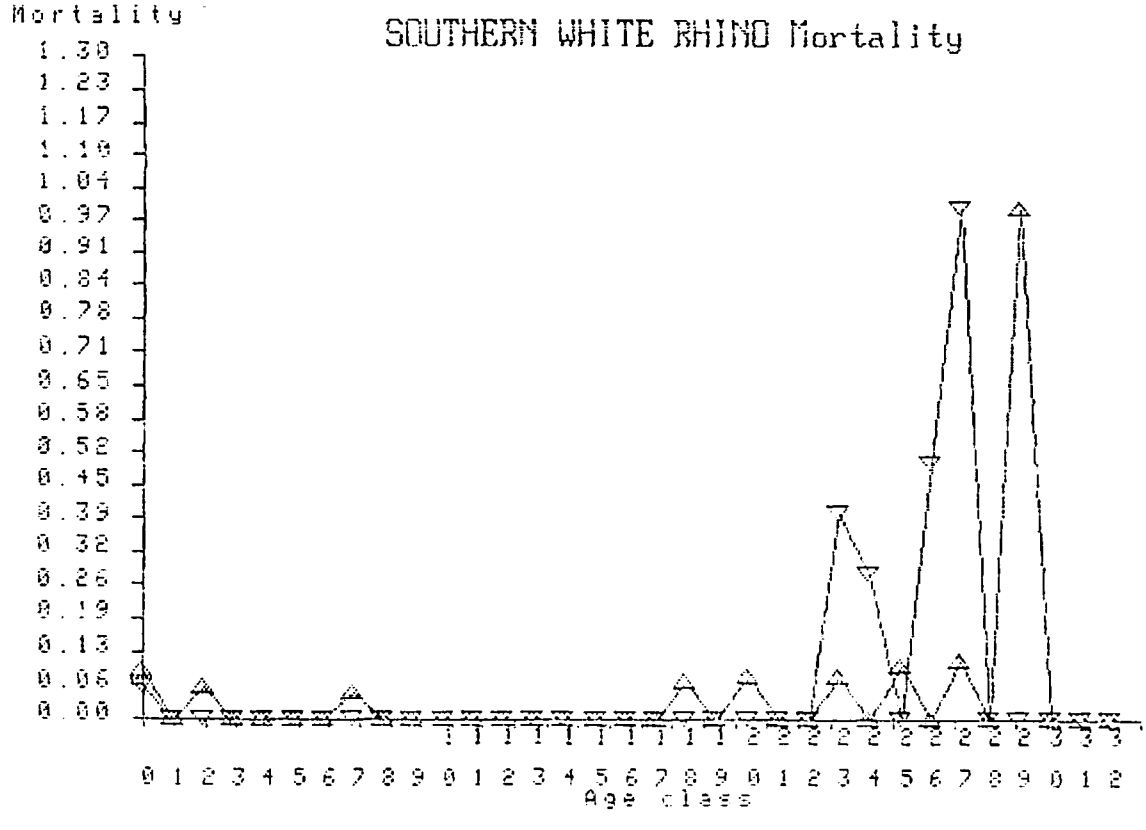
16 birth events to known age parents tabulated for Mx...

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

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

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2
Data current thru: 1 Jun 1993 AUSTRALASIAN ZOOS
Jul 1993


SOUTHERN WHITE RHINO Fecundity
Fecundity
0.36
0.34
0.32
0.31
0.29
0.27
0.25
0.23
0.22
0.20
0.18
0.16
0.14
0.13
0.11
0.09
0.07
0.05
0.04
0.02
0.00
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
Age class
females
males


SOUTHERN WHITE RHINO Mortality
Mortality
1.30
1.23
1.17
1.10
1.04
0.97
0.91
0.84
0.78
0.71
0.65
0.58
0.52
0.45
0.39
0.32
0.26
0.19
0.13
0.06
0.00
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2
Age class

.....

Smoothing pass 1

Age Class	Fecundity [Mx]... Male	N	Female	N	Mortality [Qx]... Male	N	Female	N
0- 1	0.00	14.2	0.00	19.0	0.06	15.5	0.09	22.1
1- 2	0.00	14.3	0.00	18.9	0.00	14.3	0.03	18.8
2- 3	0.00	15.0	0.00	18.1	0.00	13.3	0.02	17.4
3- 4	0.00	15.0	0.00	18.0	0.00	15.0	0.02	17.7
4- 5	0.00	15.0	0.00	18.0	0.00	14.4	0.00	16.5
5- 6	0.00	14.7	0.01	19.0	0.00	13.7	0.00	18.9
6- 7	0.00	12.5	0.01	19.0	0.00	12.5	0.02	19.0
7- 8	0.00	12.0	0.01	19.6	0.00	12.0	0.02	19.0
8- 9	0.00	11.6	0.00	19.1	0.00	11.6	0.02	19.1
9-10	0.00	11.0	0.00	18.0	0.00	11.0	0.00	18.0
10-11	0.00	10.1	0.01	18.0	0.00	9.7	0.00	17.7
11-12	0.02	10.0	0.02	18.0	0.00	10.0	0.00	18.0
12-13	0.05	9.8	0.02	17.7	0.00	9.8	0.00	17.7
13-14	0.07	9.0	0.03	17.0	0.00	9.0	0.00	17.0
14-15	0.08	8.2	0.05	16.3	0.00	7.4	0.00	15.7
15-16	0.06	8.0	0.05	16.0	0.00	8.0	0.00	16.0
16-17	0.06	8.0	0.04	16.0	0.00	8.0	0.00	16.0
17-18	0.08	8.0	0.02	16.0	0.00	8.0	0.02	16.0
18-19	0.11	8.0	0.02	15.9	0.00	7.6	0.02	15.0
19-20	0.09	8.0	0.05	15.0	0.00	8.0	0.05	15.0
20-21	0.06	8.0	0.05	13.0	0.00	8.0	0.03	13.0
21-22	0.02	8.0	0.05	13.0	0.00	8.0	0.03	13.0
22-23	0.11	7.9	0.01	13.0	0.13	7.1	0.03	13.0
23-24	0.09	5.5	0.03	12.0	0.23	5.0	0.03	12.0
24-25	0.15	3.5	0.03	11.5	0.23	3.5	0.06	11.5
25-26	0.06	3.0	0.03	10.0	0.26	3.0	0.03	10.0
26-27	0.06	2.0	0.00	10.0	0.50	2.0	0.07	10.0
27-28	0.00	1.0	0.00	9.0	0.50	1.0	0.04	9.0
28-29	0.00	1.0	0.00	9.0	0.33	1.0	0.37	9.0
29-30	0.00	1.0	0.00	1.0	0.00	1.0	0.33	1.0
30-31	0.00	1.0	0.00	1.0	0.00	1.0	0.33	0.0
31-32	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
32-33	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
33-34	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0

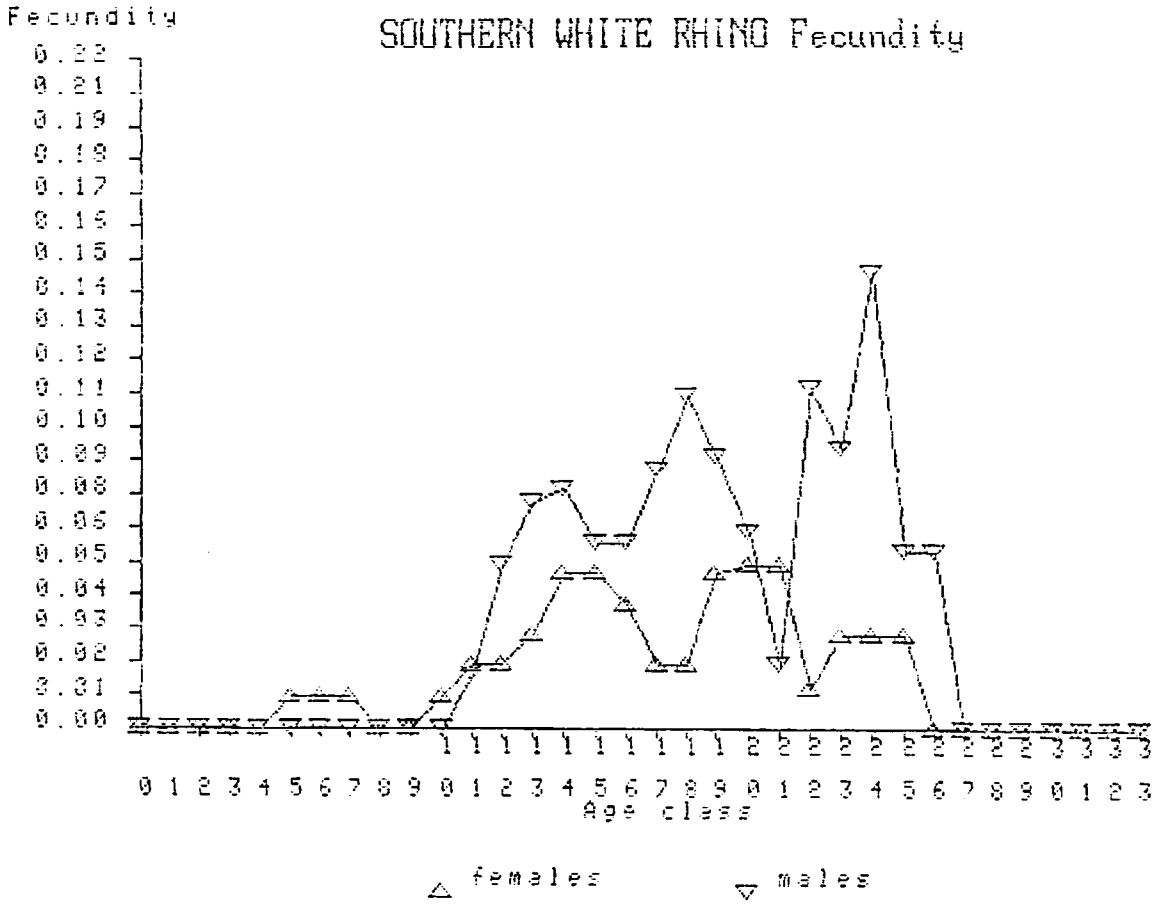
T = 18.166	T = 16.859	30 day mortality: 6%
Ro = 0.907	Ro = 0.409	(2 out of 36)
lambda=0.99	lambda=0.95	
r = -0.005	r = -0.053	

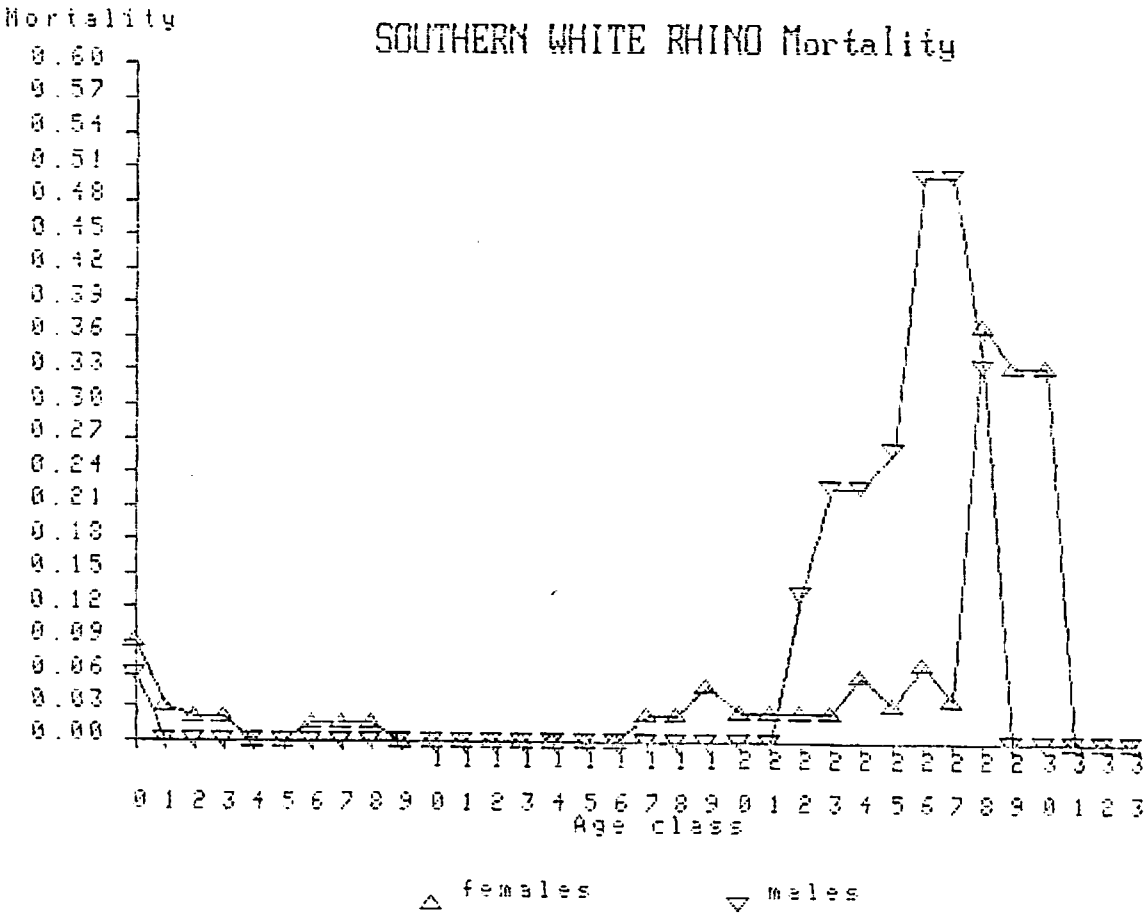
16 birth events to known age parents tabulated for Mx...plus...
1 births to UNK or MULT dams...
1 births to UNK or MULT sires...

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

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

Compiled by: PAUL GARLAND thru Orana Park Wildlife Trust
SPARKS v1.2


SOUTHERN WHITE RHINO Fecundity
Fecundity
0.22
0.21
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Age class
females
males


SOUTHERN WHITE RHINO Mortality
Mortality
0.60
0.57
0.54
0.51
0.48
0.45
0.42
0.39
0.36
0.33
0.30
0.27
0.24
0.21
0.18
0.15
0.12
0.09
0.06
0.03
0.00
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3
Age class
females
males

Capacity 2.11

Effective Size and Carrying Capacity Necessary for Maintaining the Specified Amount of Genetic Diveristy for the Specified Amount of Time

Number of Years per Generation:	16.8	# Generations during 100 Years:	5
Yearly Growth Rate (lambda):	1.010	Exponential Growth Rate (r):	0.010
Effective Number of Founders:	19	Growth rate per Generation:	1.182
Estimated Ne/N Ratio:	0.50	Exponential Growth/Gener:	0.167
Desired % Hetero. Retain:	90.0		
Length of Time Period (Years):	100		

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 100 Years: 27

Actual Carrying Capacity Required (Based on Ne/N Ratio): 54

=07/14/93= j.ballou Mar'89 ===

Capacity 2.11

Effective Size and Carrying Capacity Necessary for Maintaining the Specified Amount of Genetic Diveristy for the Specified Amount of Time

Number of Years per Generation:	16.8	# Generations during 100 Years:	5
Yearly Growth Rate (lambda):	1.050	Exponential Growth Rate (r):	0.049
Effective Number of Founders:	19	Growth rate per Generation:	2.270
Estimated Ne/N Ratio:	0.30	Exponential Growth/Gener:	0.820
Desired % Hetero. Retain:	90.0		
Length of Time Period (Years):	100		

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 100 Years: 26

Actual Carrying Capacity Required (Based on Ne/N Ratio): 87

=07/14/93= j.ballou Mar'89 ===

Capacity 2.11

Actual Carrying Capacity Required to Maintain 90.0% of the Original Heterozygosity for Various Time Periods Under Various Ne/N Ratios

LENGTH OF PROGRAM (YEARS)

Ne/N Ratio	50	75	100	150	200
0.10	100	190	260	450	670
0.20	50	95	130	225	335
0.30	33	63	87	150	223
0.40	25	48	65	113	168
0.50	20	38	52	90	134

Table Parameters

Lambda:	1.050
Gen. Length:	16.8
No. Fndrs:	19

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

REVIEW DRAFT

1 JULY 1992

SECTION 3

WHITE RHINO

WHITE RHINO

Working Group: *Paul Garland, Martin Brooks, Nick Linsay, Robert Reece, Oliver Ryder, Petr Spala, Kristina Tomasova, Wim Verberkmoes*

SOUTHERN WHITE RHINOCEROS

Review of Wild Population

1991 = 5560 in free ranging populations.

Estimated 6 generations since bottle neck of 20-100 animals (1900). No inbreeding problems detected to date as evidenced by high reproductive rate. Also small populations were dispersed within the region and have not reflected any inbreeding problems.

Between 1987 - 1991 there has been a natural increase in the world population of 5.2% per annum.

In the last 3 years there has been significant increase in poaching of white rhino throughout the region. As an example in 1991 the Swaziland population was estimated at 60 animals but is now possible down to 13 due to recent poaching activities.

Recommendations: (Wild Populations)

1. Protect in situ Core Populations. We have identified 6 core populations in Southern Africa as follows:

   - Hluhluwe/Umfolozi Population 1988
     Number 1 priority to protect core poopulation as it represents the best genetic base - now close to carrying capacity.
   - Itala Game Reserve Population 160.
   - Mkuzi Game Reserve Population 132
   - Pilanesberg National Park Population 201
   - Krueger National Park Population 1065
     Carrying capacity is much higher than current level.
   - Hwange National Park Population 100

   A. Continue to liase with African Rhino Specialist Group to monitor the ongoing status and population trends in these key areas.

   B. To liase with the African Rhino Specialist Group to identify projects that the zoo community could assist in.

2. Support Populations Outside South Africa.

   A. Recognize that Hwange National Park, Zimbabae offers the best medium opportunity for reinforcing in situ populations outside of South Africa.

   B. Liase with the African Rhino Specialist Group to establish priorities and projects to achieve the above.

3. Genetic Resource Banking.

   A. Develop artificial reproductive techniques that will asssist in the establishment of protocols and procedures to support genetic resource banking.

4. Support Anti-Poaching

   A. Liase with the African Rhino Specialist Group to establish the role of the zoo community in assisting anti-poaching and to establish priorities.

Review of Captive Population

USA - 122 of which about 50 are contributing to population growth. Similar situation with limited breeding exists in Europe.

No more than 30% of world captive population is estimated to be breeding or in breeding situations at this time.

Therefore we estimate the effective population of white rhino in captivity at about 180 individuals.

Recommendations: (Captive Populations)

1. Size of Captive Population.

   A. Action plan be developed by the regional taxon coordinators to determine the global minimum viable populations. Develop management plans for regional subsets and determine frequency of migrations between populations.

   B. The current managed populations (SSP/JSMC/EEP/ASMP) are now recognized as being actively managed to meet the global MVP recommendations. Other regions need to be included.

2. Action Plan.

A. Regional taxon coordinators be responsible for the establishment of the CAP by December 1992.

3. Regional Capacity.

A. Regional coordinators to define regional capacity by September 1992.

4. Artificial Breeding Techniques.

A. Establish 2 separate research populations, one in Europe/UK and one in North America.

B. Regional taxon coordinators to identify suitable animals and best research site in liason with research group.

C. Develop funding sources to undertake the artificial breeding research program.

NORTHERN WHITE RHINOCEROS

Review of Wild Population

The current wild population is limited to 31 animals in the Garamba National Park in Zaire and is expanding steadily at 10% per annum.

It is under threat from civil war.

Recommendations: (Support by Captive Community)

1. Support Garamba Population.

A. Liase with current in situ support organization (Frankfurt Zoological Society/National Parks Authority in Zaire) to identify and priortize project needs.

2. Genetic Resource Banking. (As for Southern White Rhino)

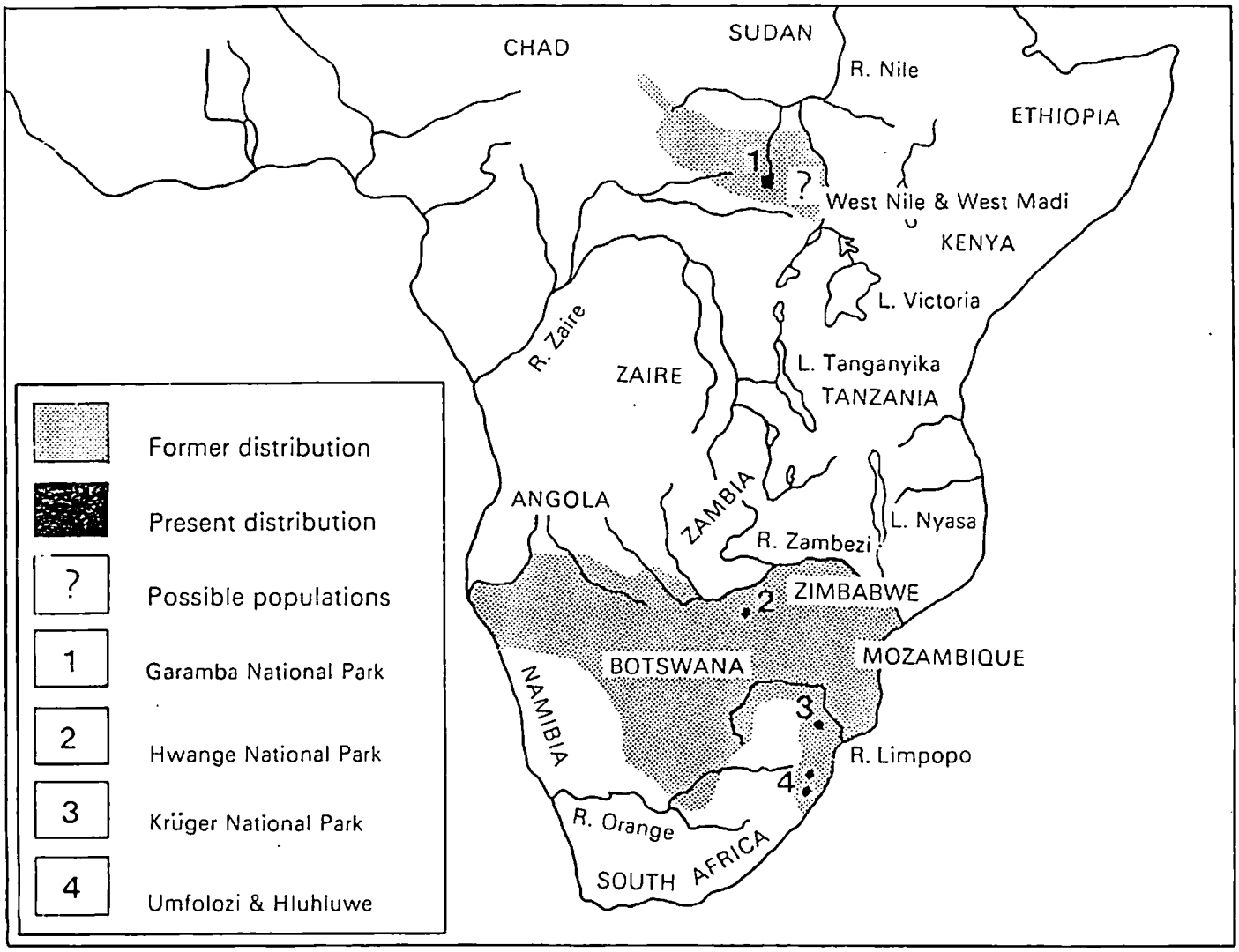
Review of Captive Population

Population about 10 and is distributed between Dvur Kralove and San Diego. There has been poor reproduction which places the entire captive population in jeopardy.

TABLE 2
GLOBAL AND REGIONAL
CURRENT AND TARGET POPULATIONS FOR
RHINO IN CAPTIVITY

	WORLD			AFRICA		ASIA		AUSTRALASIA		EUROPE		N. AMERICA		C.& S. AMERICA	
RHINO TAXON	WILD POP	CPTV POP	CPTV TRGT	CPTV POP	TRGT POP	CPTV POP	TRGT POP	CPTV POP	TRGT POP	CPTV POP	TRGT POP	CPTV POP	TRGT POP	CPTV POP	TRGT POP
Eastern Black	600	163	200	5	5	35	40	2	0	55	65	67	90	6	?
Southern Black	2,300	42	175	4	15	2?	0	0	80	6	0	30	80	0	?
Southwestern Black	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North & West Black	<100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern White	31	10	?	0	?	0	0	0	0	6	?	4	?	0	0
Southern White	5,560	570	200 + 100 Rsrch	24	0	150	0	14	60	210	70 + 50 Rsrch	132	70 + 50 Rsrch	40	?
Indian/Nepali	1,700	120	230	0	0	45	78	0	0	32	76	40	76	1	?
Javan (Java)	< 75	0	?	0	0	0	?	0	0	0	0	0	0	0	?
Javan (Vietnam)	< 25	0	?	0	0	0	?	0	0	0	0	0	0	0	?
Mainland Sumatran	150	8	150	0	0	8	50	0	0	0	100	0	0	0	?
Sumatran Sumatran	600	13	150	0	0	7	50	0	0	2	0	6	100	0	0
Borneo Sumatran	100	2	150	0	0	3	50	0	100	0	0	0	0	0	0
African Rhino	8,991	785	675	33	20	189	40	16	140	266	185	233	290	46	?
Asian Rhino	2,650	143	680	0	0	63	228	0	100	34	176	46	176	1	?
All Rhino Taxa	11,641	928	1355	25	20	252	268	16	240	300	361	279	466	47	?

T.J. Foose
15 June 1992



Map 2: Past and present distribution of the white rhinoceros