Rhino Global Captive Action Plan

Regional Captive Propagation Programs

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

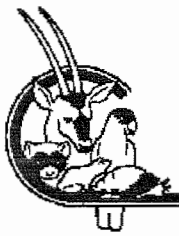
EDITED BY
THOMAS J. FOOSE, PH.D.
IUCN /SSC CBSG

A Joint Endeavor of the

IUCN/SSC Captive Breeding Specialist Group
&
Regional Captive Propagation Programs

with Input from the

IUCN/SSC Asian Rhino Specialist Group
&
IUCN/SSC African Rhino Specialist Group



Regional Captive Propagation Program

A contribution of the IUCN/SSC Captive Breeding Specialist Group, Regional Captive Propagation Programs, the IUCN/SSC Asian Rhino Specialist Group, and the IUCN/SSC African Rhino Specialist Group.

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1 April 1995

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SECTION 1

SUMMARY & OVERVIEW

OVERVIEW OF THE WORLD'S RHINOS

- At maximum, there are 12 or 13 (if *Dicerorhinus sumatrensis lasiotis* still survives) distinct taxa of rhino that may deserve conservation efforts as separate units.

- All 13 taxa are threatened with extinction. In terms the new Mace-Lande (1991) categories and criteria: 7 (or 8) are critical, 4 are endangered, 1 is vulnerable. (Table 1)

- There are an estimated 11,640 rhino surviving in the wild: 8991 African, 2650 Asian. Thus, 77% of the surviving wild rhino are African, indeed 48% (almost half) are southern white rhino; 23 % of the surviving wild rhino are Asian. (Table 2)

- The surviving wild rhino occupy 40 major protected areas: 20 African and 20 Asian. (Table 3).

- A conservative estimate of the operating budgets for these protected areas is US $20,000,000 (Table 4).

- 8 of the 13 taxa are present in captivity (Table 2).

- There are 928 rhino registered in captivity: 785 African, 143 Asian. (Table 2) Captive specimens represent about 7.5% of the surviving rhino on the planet.

- Combining wild and captive, there are an estimated 12,569 rhino on the planet.

- At least 290 captive facilities worldwide maintain specimens of at least 1 taxon of rhino (Table 5). 266 facilities maintain African rhino; 52 maintain Asian rhino. At least 200 of the captive facilities for rhino are in "hard currency" countries and have combined annual operating budgets of US $ 1,000,000,000.

- Organized Captive Propagation Programs are in progress in 5 Regions of the zoo/aquarium world:

	Australasia	Japan	India	Europe	North America	S.E. Asia
Black	X			X	X	X
White	X	X		Soon	X	
Indian/Nepali		X	X	X	X	
Sumatran	Proposed			Soon	X	X

- The rates of growth (Table 6) are lower for all taxa in captivity than in adequately protected areas of the wild. However, rates of growth are improving.

- The potential genetic foundation for 4 (Eastern Black, Southern Black, Southern White, and Indian/Nepali) of the 8 taxa in captivity is good (Table 7) and the amount of the wild gene pool still retainable is high > 90 % (Tables 8 & 9). The genetic foundation of the 3 Sumatran taxa needs to be reinforced. The genetic foundation of the Northern white rhino population is limited and additional reinforcement is not advisable at this time.

- The distribution of genetic diversity is uneven among the Regional programs (Tables 7-9).

BACKGROUND

INTRODUCTION

This document represents the first version of a Global Captive Action Plan (GCAP) for Rhino. It is the result of Workshop conducted at the Zoological Society of London 9-10 May 1992.

The purpose of this GCAP is to provide a strategic overview and framework for effective and efficient application and allocation of captive resources to rhino conservation. A primary focus of the GCAP is on captive propagation programs that can serve as genetic and demographic reservoirs to support survival and recovery of wild populations in the future. While captive breeding programs are emphasized in the GCAPs, the Plans also attempt: (1) to identify where and how the captive community can assist with transfer of intensive management information and technology to the wild; (2) to develop priorities for the limited financial support the captive community can provide for *in situ* conservation (e.g., adopt-a-sanctuary programs).

GCAPs are developed by a Global Action Plan Working Group which includes representatives from each of the Regional Captive Programs. The GCAPs provide a strategic framework within which the Taxon Advisory Groups (TAGs) in the various organized Regions (ASMP, EEP, SSP, SSCJ) of the zoo and aquarium world will formulate and implement their own Strategic Regional Collection Plans. In reality, Global and the Regional Plans will be interactively and iteratively developed. The Regional TAGs are integrally involved in the development of the Global Captive Action Plans. (Figure 1)

Ideally, the Regional TAGs then consider this first draft of the GCAP within a regional context to develop a draft of a Regional Collection Plan (RCP). Once draft Regional Plans are formulated, the GCAP process continues as the RCP's of various regions are reviewed at the global level in an attempt to coordinate and, where necessary and agreeable, adjust Regional priorities in an attempt to maximize effectiveness of the international captive community in responding to conservation needs. The GCAP and RCP process are thus both interactive and iterative. In this way RCP's of the various Regions will not develop in isolation from one another and captive resources can be allocated efficiently and effectively to taxa in need.

Ultimately, the GCAP will recommend how responsibilities for captive programs might best be distributed among organized Regions of the global captive community. Further, the Global Captive Action Plan Working Groups will facilitate interaction and coordination among Regional TAGs as they develop their Regional Collection Plans and Regional Breeding Programs in an attempt to optimize use of captive space and resources for conservation on an international basis.

The Regional TAGs will most accurately assess captive holding/exhibit space in their Regions using surveys and censuses to supplement studbook databases, ISIS records, national or regional inventories, etc. It is through the Regional Collection Plans and the Regional Breeding Programs developed thereunder that the recommendations of the Global Captive Action Plans will be realized. However, to maximize the efficiency and effectiveness of captive resources, Regional Programs will need to be integrated and coordinated to form global programs, i.e. the Global Animal Survival Plans (GASPs).

Any and all taxa that are maintained in captivity should be managed as populations. Hence, once taxa are selected for captive propagation, they must be managed by Regional (RCPP) and Global (GCPP or GASP) Captive Propagation Programs. Therefore there should be studbooks, coordinators, masterplans, taxon advisory groups or other management provisions for these taxa. Moreover, animal spaces as well as the animals themselves should be managed. If zoos and aquaria are to respond to the need and aspire to goals such as suggested in will increasingly need to be more collective, i.e. more through Taxon Advisory Groups rather than individual taxon management and/or propagation committees. Hence in the case of the rhinos, it is proposed that a Global Propagation and Management Group (Figure 2) be organized to develop and implement the Global Action Plan which in essence will encompass the GASP's for all taxa being maintained in captivity. Further, realizing that human resources are often the most limited, the Rhino GCAP recommends creation of a paid position to act as chair of this Global Committee.

CAMPs

GCAPs are actually one product of a broader process known as Conservation Assessment and Management Plans (CAMPs). As populations of wildlife like rhino are reduced and fragmented in the wild, more intensive management becomes necessary for their survival and recovery. This intensive management may include, but is not limited to, captive breeding (Figure 3). CAMPs provide strategic guidance for application of intensive management techniques to threatened taxa.

Conservation strategies and action plans for threatened taxa must be based on viable populations, i.e. sufficiently large and well distributed to survive stochastic risks as well as deterministic threats. Viable conservation strategies and action plans also frequently will require management in addition to protection for small populations.

Viable population strategies may often require that the taxa be managed as metapopulations, i.e. systems of disjunct subpopulations that are interactively managed with regulated interchanges among them and interventions within them to enhance survival of the taxon (Figure 4). The management actions may include: establishment, enlargement, or more management of protected areas; poaching control; reintroduction or translocation; captive breeding; sustainable use programs; education efforts. (It's so much easier working with extinct species, they much less controversial.)

Viable metapopulations often will probably need to include captive components. The IUCN Policy Statement on Captive Breeding (IUCN 1987) recommends in general that captive propagation programs be a component of conservation strategies for taxa whose wild population is below 1000 individuals.

CAMPs are developed as collaborative efforts of the IUCN/SSC CBSG with the other taxa-based IUCN/SSC Specialist Groups and the Regional Taxon Advisory Groups of the zoo/aquaria community worldwide. Within the Species Survival Commission (SSC) of IUCN, the primary goal of the Captive Breeding Specialist Group (CBSG) is to contribute to the development of holistic (i.e. integrating *in situ* and *ex situ*) and viable conservation strategies and action plans by the taxa-based Specialist Groups of the SSC.

The CAMP process reviews the wild and captive status of all taxa in the taxonomic group under consideration, on a taxon-by-taxon basis. CAMPs assess the degree of threat for each taxon in the wild and recommend intensive action that may reduce the risks for threatened taxa. For this purpose, the process utilizes information from SSC Specialist Groups and their Action Plans as well as additional data from experts on the taxa.

Concerning taxonomy, the most conservative approach, relative to the preservation of biodiversity, is to attempt risk assessment and management recommendations initially in terms of the maximal distinction among possible "subspecies" until taxonomic relationships are better elucidated. Splitting rather than lumping maximizes preservation of options. Taxa can always be merged ("lumped") later if further information invalidates the distinctions or if biological or logistic realities of sustaining viable populations precludes maintaining taxa as separate units for conservation.

The CAMP process is also providing an opportunity to test the applicability of the Mace/Lande Criteria (Conservation Biology) as a major consideration for assessment of threat. The Mace/Lande system is being considered as the new IUCN Categories of Threat and are still under active development. The scheme attempts to assess threat in terms of likelihood of extinction within a specified period of time.

The proposed system defines 3 categories for threatened taxa:

Critical 50% probability of extinction within 5 years or 2 generations, whichever is longer.

Endangered 20% probability of extinction within 20 years or 10 generations, whichever is longer.

Vulnerable 10% probability of extinction within 100 years.

Criteria are proposed to estimate the risk of extinction of taxa and assign a degree of threat based on information about size, distribution, and trend of their population as well as conditions of their habitat. Their purpose is to provide a system that is more objective and rational than previous schemes have been. Definition of these categories and assessment of threat is based on population viability theory. Table 1 contains a Mace-Lande risk assessment for rhino taxa.

Based on these assessments, the CAMP process provides a set of recommendations about which taxa are in need of various kinds of intensive management attention, especially involving the captive community. At the CAMP level, the recommendations for intensive management are provided for use by managers of both wild and captive populations.

GCAPs

The GCAP specifically relates the CAMP process to the captive community. GCAPs recommend what the captive community could and should attempt to contribute to the intensive management needs of the threatened taxa.

(1) Population and Habitat Viability Assessment and Conservation Management Plan (PHVA) Workshops.

(2) Intensive (captive-type) protection and management in the wild
   (A) identifying where and how the captive community can assist with transfer of intensive management information and technology (i.e., recognizing natural sanctuaries as megazoos.)
   (B) developing priorities for the limited financial support the captive community can provide for *in situ* conservation (e.g., adopt-a-sanctuary programs)

(3) *In situ* and *ex situ* research where the captive community can reasonably assist: e.g., taxonomic clarification, some survey support.

(4) Captive propagation programs that sooner or later could be linked to interactions with wild populations;

(5) Genetic resource banking and application of reproductive technology, which will become available to enhance populations of animals in captivity, and the wild. Major initiatives are under way to establish a comprehensive and coordinated system of genetic resource banks.

In general, captive populations and programs can serve three roles in such holistic conservation strategies:

(A) Living ambassadors that can educate the public at all levels and can generate funds for *in situ* conservation.

(B) Scientific resources that can provide information and technologies beneficial to protection and management of populations in the wild.

(C) Genetic and demographic reservoirs that can be used to reinforce survival of taxa in the wild either by revitalizing populations that are languishing in natural habitats or by re-establishing populations that have become extinct.

The third of these roles may often be a benefit for the longer term as return to the wild may not be a prospect for the immediate future. However, it is proposed that captive and wild populations should and can be intensively and interactively managed with interchanges of animals occurring as needed and as feasible (Figure 4). There may be many problems with such interchanges including epidemiologic risks, logistic difficulties, financial limitations, etc. But with effort, based on limited but growing experience, these problems can be resolved. The bottom line is that strategies and priorities should try to maximize options and minimize regrets. Captive populations are support, not a substitute, for wild populations.

Where captive programs are recommended by CAMPs and GCAPs, there is an attempt to propose the level of captive programs required, reflecting status and prospects in the wild as well as taxonomic distinctiveness. The level of captive program is defined by its genetic and demographic objectives which translate into a target population size (i.e., how many to ultimately maintain) that will be required to achieve these objectives. Target population depends on a number of factors:

- level of demographic security
- kind and amount of genetic diversity
- period of time
- size of the wild population
- size of other captive populations of similar species
- reproductive technology available

There will be multiple genetic and demographic objectives depending on the status and prospects of the taxon in the wild and hence different captive population targets: some taxa need large populations for a long time; others need small incipient nuclei or reduced gene pools that can be expanded later if needed.

The approximate scheme that has evolved for Global Captive Action Plans so far is:

Captive Recommendation	Level of Captive Program
90% / 100 Years I	Population sufficient to preserve 90% of the average heterozygosity of the wild gene pool for 100 years, developed as soon as possible (1-5 years).
90% / 100 Years II	Population sufficient to preserve 90% of the average heterozygosity of the wild gene pool for 100 years but developed more gradually (5-10 years).
Nucleus I	A captive nucleus (50-100 individuals) to always represent 98% of the wild gene pool. This type of program will require periodic, but in most cases modest immigration/importation of individuals from the wild population to maintain this high level of genetic diversity in such a limited captive population. Reproductive technology will facilitate this strategy.
Nucleus II	A well managed captive nucleus (25-100) for taxa not of conservation concern but present in captivity or otherwise of interest.
Elimination	Taxa are not of conservation concern and are not otherwise of interest. The population should be managed to extinction.

The program goals for 90%/100 Years I and II taxa are different from what has been recommended as the general guideline for captive programs in the past, i.e. 90% of genetic diversity for 200 years. A shorter time period is proposed for 2 reasons:

- It buys time for more taxa that might be excluded from captive programs if a longer time period (e.g. 200 years) is adopted.
- It maintains more incentive to secure or restore viable populations *in situ*.

Captive programs at the 90/100 I level are recommended for 7 taxa of rhino: Eastern Black, Southern Black, Southern White, Indian/Nepali, and 3 geographical varieties of Sumatran Rhino (representing the populations on Sumatra, Borneo, and in Peninsular Malaysia). Additionally, a last, crash effort is recommended to attempt to develop a successful breeding program with the Northern White Rhino in captivity. If this effort does succeed, the GCAP will probably adjust its recommendation concerning the level of captive program for this taxon.

Computer models and software exist (Ballou 1991) to establish rough targets based on the genetic and demographic considerations. During the Workshop, Simon Wakefield, Georgina Mace, and Tom Foose assisted the Taxon Working Groups with these analyses. Results of such calculations for various taxa of rhino are presented in Section 9. These analyses were used by the Working Groups to recommend target population objectives for their taxa. Target population size objectives are recommended at both the global and regional level. (Table 2).

GCAPs must also confront the realities of limitation in captive habitat (space and other resources. The priorities for captive propagation must be reconciled by the potential or capacity of zoos and aquaria. TAGs in many Regions are now conducting surveys of the amount of captive space available. These surveys are rather sophisticated considering the captive ecologies and taxonomic affinities of the taxa, zoogeographic themes of the institutions. The recommendations for target size require an expansion of rhino space in zoos by 46% over the next 15 years. Initial surveys in North America and some preliminary indications for Europe suggest such expansion is feasible and likely. The recommendations also entail adjustments to current sizes of captive populations, e.g., the Rhino GCAP is recommending that the captive population of Southern White Rhino be reduced while the populations for the other rhino taxa are recommended to increase.

A Glossary of the relationships among the CAMP, GCAP, etc. is provided in Section 11.

WORKSHOP

As is usual, the CAMP and GCAP process for rhinos was initiated by a Global Workshop. Participants included the International and Regional Studbook Keepers and most of the Regional Species Coordinators for each of the rhino taxa, African and Asian. Also participating were the Chairs of the African and Asian Rhino Specialist Groups as well as a few of their other members. A list of participants is included at the end of this Section. Also appended is the agenda for the Workshop.

Also appended is a draft agenda for this Workshop. The Workshop commenced with a plenary session in which some overview and orientation were presented. All participants then formulated the goals and objectives for the Workshop.

Goals:

- Prepare the first draft of a Rhino Global Captive Action Plan:
  - This Plan will include goals, priorities, guidelines for both *ex situ* and *in situ* rhino conservation activities by zoos worldwide.
  - The Plan will be the first step in a continuing process to develop a truly global effort by zoos in rhino conservation through facilitation and coordination of interactions among the various Regional programs.

- Form a Rhino Global Captive Propagation and Management Committee as the vehicle for continuing development of the Global Captive Action Plan.
  - This Committee will consist of the various Regional Rhino Coordinators at both the single taxon and the taxon advisory group (TAG) level.
  - The Committee will also invite the Chairs of the SSC Rhino Specialist Groups to serve as advisors.
  - Other advisors will be appointed by the Committee.
  - The Committee will have assigned Responsibilities

Objectives:

- Recommend intensive management actions for each taxon.
  - Population and habitat viability analyses (PHVA),
  - Problem-oriented research,
  - More intensive in-situ management,
  - Captive breeding
- Confirm which rhino taxa are to be selected for captive breeding programs.
- Establish target populations for those taxa to be maintained in captivity.
- Identify expansion in the capacity of captive facilities needed to accommodate these target populations.
- Suggest interactions between regional programs that may be beneficial to the captive propagation programs for the various taxa.
- Prioritize *in situ* protected areas, important populations, and significant projects for financial and technical support by zoos.
  - In particular, propose a plan for Regional responsibilities for *in situ* conservation.
- Delineate and prioritize research (conservation) both by species and also by family
- Compile a statement of goals and objectives for each species/taxon
- Consider "subspecies" (geographically distinct population) issues:
  - Assess current state of information
  - Describe a further process for arriving at conclusive guidelines for how captive community will treat possible subspecies, i.e. geographically defined populations.

After this plenary session, participants then divided into Working Groups:

- 4 were taxa-oriented: Black Rhino, White Rhino, Indian/Nepali Rhino, Javan & Sumatran Rhino;
- 4 were problem oriented: Research, Systematics, In Situ Support, and Target Population.

Periodically, the working groups reconvened into plenary session for review and refinement of their work in relation to the other groups. A final plenary session synthesized the various results into the Rhino Global Captive Action Plan which is reported here.

The results of the Workshop, i.e. the first version of the Global Captive Action Plan, are presented as:

(1) a collection of overviews in both narrative and tabular form of the status of rhinos;
(2) a set of goals, objectives and recommendations.
(3) a series of reports from each of the working groups.

GLOBAL CAPTIVE ACTION PLAN

GOALS

- **Affirm that the paramount purpose of captive programs for rhino conservation is the survival and recovery of all distinct taxa in the wild.**

- **Contribute to rhino conservation by:**

  - **Developing, maintaining, and using captive breeding programs to provide a genetic and demographic reserve to re-establish or revitalize wild populations when the need and opportunity occurs.**

  - **Conducting problem-oriented research that will contribute to management of rhino in both captivity and the wild; collaborating on such research where appropriate with field researchers; communicating and transferring the results of such research to managers of other captive and wild populations**

  - **Providing where possible financial as well as technical support for *in situ* conservation.**

OBJECTIVES/RECOMMENDATIONS

- **Conduct captive breeding programs for selected taxa of rhino. 7 taxa currently selected are:**

- *Diceros bicornis michaeli*	Eastern Black
- *Diceros bicornis minor*	Southern Black
- *Ceratotherium simum simum*	Southern White
- *Rhinoceros unicornis*	Indian/Nepali
- *Dicerorhinus sumatrensis harrisoni.*	Borneo Sumatran
- *Dicerorhinus sumatrensis sumatrensis I**	Sumatra Sumatran
- *Dicerorhinus sumatrensis sumatrensis II**	Mainland Sumatran

(* Peninsular Malaysian and Sumatran populations treated as distinct taxa)

- **Additionally, conduct a crash effort to initiate a captive breeding program for *Ceratotherium simum cottoni*, using the founder stock already in captivity.**

If this program were successful, space could and would be allocated, perhaps by reducing the captive habitat occupied by southern white rhino.

- **Form a special task force to conduct the crash program for the Northern white rhino.**

The initial members appointed to this group are: Larry Killmar, Nick Lindsay, Bob Reece, Ollie Ryder, Kristina Tomasova, Tom Foose.

- **Consider other taxa for captive breeding at the request and recommendation of the SSC Rhino Specialist Groups in the future if the situation in the wild dictates and in captivity permits (space, husbandry): e.g. *Rhinoceros sondaicus*, the Javan.**

- **Adopt a policy of recognizing the maximum number of distinct taxa for conservation action until or unless further information indicates a taxon no longer should be treated as a separate unit.**

- **Assist the SSC Rhino Specialist Groups in collecting information needed to decide what constitute distinct taxa of rhino and recognize the Specialist Groups as the ultimate authority on this issue.**

- **Use the assistance available from zoos for the other taxa to support *in situ* efforts.**

- **Establish captive target populations in general sufficient to preserve 90% of the gene diversity of the wild populations for 100 years.**

- **Attain designated target populations (Table 1) for the taxa in captivity within 1 rhino generation (~ 15 years) for the Eastern Black, Southern White, and Indian/Nepali; within 2 generations (~30 years) for the Southern Black and the 3 Sumatran taxa.**

Taxa	Current Population	Target Population	% Increase	
			Total	Per Year
Eastern Black	163	200	22%	1.3%
Southern Black	52	175	337%	4.0%
Southern White	570	300	- 49%	4.2%
Indian/Nepali	120	230	92%	4.5%
Borneo Sumatran	2	150	750% *	7.0%
Mainland Sumatran	8	150	750% *	7.0%
Sumatra Sumatran	13	150	750% *	7.0%

* Based on premise that Current Population, consisting of founders, will be rapidly augmented by rescue of more rhino from wild so that initial number will be 20.

- **Distribute responsibilities for the captive populations over the various Regions of the zoo world as indicated in Table 2.**

- **Expand the captive capacity for rhino from 928 to 1355, i.e. 427 new spaces, an increase of 46% over a 15 year period (i.e. 1 rhino generation).**

  This rate of expansion will require creation of about 30 new spaces/year in zoos worldwide.

- **Reallocate existing rhino space (785 African spaces of which 570 are for southern white rhino; 143 Asian spaces) to achieve the target distribution of 675 African spaces, 680 Asian spaces.**

  A conclusion of these calculations is that most new rhino spaces will need to be "Asian".

- **Redistribute founder material among the Regional Programs for selected taxa to provide more viable genetic foundations within all of the Regions.**

  This is especially true for the Indian/Nepali Rhino where movement of new founder material into Europe and from Asia to both Europe and North America would be beneficial.

- **Obtain additional founders from the wild for several of the taxa to be propagated in captivity in order to provide a viable genetic foundation for the population.**

	Existing	Additional	Total
Borneo Sumatran	2	18	20
Mainland Sumatran	8	12	20
Sumatra Sumatran	13	7	20

- **Accord the highest priority to research in 3 areas which are critical for conservation programs for rhino:**

  - **Genetic studies to clarify taxonomic status of "subspecies", i.e. geographically defined populations;**

  - **Veterinary and husbandry investigations to ameliorate the disease syndrome that afflicts the Black, and possibly other browsing rhino, in captivity, and probably in the wild.**

  - **Development of effective methods of assisted reproduction, especially with the objective of using these techniques to expand more rapidly the populations of the taxa in desperately low numbers, e.g. northern whites and perhaps eventually Javan.**

- **Establish a research collection of White Rhino (100 total) in both North America (50) and in Europe/UK (50) at a site determined by the Regional Coordinators.**

- **Develop aggressively the funding needed for the research priorities.**

- **Formulate a plan with defined objectives and schedules to initiate systematic genetic resource banking of rhino taxa.**

  This would be the assignment of a special task force to be formed by Dr. Betsy Dresser and Dr. Tom Foose.

- **Collaborate on habitat and population viability analyses (PHVAs) for selected taxa.**

  The most immediate need identified is a PHVA for the Indian/Nepali rhino.

- **Accept as a challenge, the objective of providing $1,000,000/year for 10 years to *in situ* rhino conservation, especially through "Adopt-A-Park" programs.**

  Distributed over the 200 "hard currency" rhino institutions (Table 2), this level of contribution is equal on the average to $5,000/institution. Considered from another perspective, this level of contribution represents just a little over $1,000 per rhino currently maintained in the zoos of the world; it will represent $ 740 once captive target populations are attained. It has been estimated that the annual cost of protecting and managing minimally viable populations of rhino in the wild is about $20,000,000/year. The level of support proposed for zoos is thus only about 5%, but if effectively applied could be very catalytic and crucial support. A number of institutions (Table 3) are already contributing to *in situ* rhino conservation at or above this level.

- **Specifically, to initiate the *in situ* program:**
  - **A. Attempt to secure $250,000/year for "adopt-a-park" programs for an additional 10 high-priority protected areas for Asian rhino by recruiting the 30 "hard currency" zoos with Asian rhinos to contribute $8,500/year for 3 years.**
  - **B. Also attempt to secure $14,000 per year to support the annual costs of the IUCN SSC/Asian Rhino Specialist Group by recruiting an additional $7,000/year from North American Zoos, $ 3,500/year from European Zoos, and $3,500/year from Australian Zoos with interests in Asian rhino.**
  - **C. Attempt to secure $250,000/year for "adopt-a-park" programs for an additional 10 high-priority protected areas for African rhino by recruiting 100 "hard currency" zoos with African rhinos to contribute $2,500/year for 3 years.**
  - **D. Also attempt to secure $27,000 per year to support the annual costs of the IUCN SSC/African Rhino Specialist Group by recruiting an additional $11,000/year from North American Zoos, $ 11,000/year from European Zoos, and $5,000/year from Australian Zoos with interests in African rhino.**

- **Establish an active Global Management and Propagation Committee to further develop and coordinate the Global Captive Action Plan.**

- **Support a paid, initially part-time position of Global Captive Rhino Coordinator to implement the Global Captive Action Plan in a timely manner; the estimated cost would be $ 20,000/year which if distributed over the 200 "hard currency" rhino institutions would be $100/year.**

- **Establish Taxon Advisory Groups (TAGs) for rhino in the Regions where they do not yet exist: Europe, Asia.**

- **Develop and implement a business plan to achieve the goals and objectives of the Global Captive Action Plan.**

  The total cost per zoo if the proposals presented above are implemented would be ~ $9,000/year for institutions with Asian rhinos and ~ $ 3,000/year for African rhino institutions.

TABLE 1
CONSERVATION ASSESSMENT & MANAGEMENT PLAN
RHINO

TAXON		WILD POPULATION									RSRCH	CAPTIVE PROGRAM	
SCIENTIFIC NAME		RANGE	EST#	SUB POP	TRND	AREA	M/L STS	THRTS	PVA/ WKSP	WILD MGMT	TAX/SRV/ HUSB	NUM	CAP REC
Diceros	bicornis												
Diceros	b. bicornis	Namibia	400	2	I	A	E	H			T,H	0	
Diceros	b. longipes	Cameroon, C.A.R.	<100	2	D	A	C	H			T,S,H	0	
Diceros	b. michaeli	Kenya, N. Tanzania	600	15	S	A	C	H	Y		T,S,H	52	90/100 I
Diceros	b. minor	S.Tanzania, Zambia, Zimbabwe, S.Africa	2,300	7	D	A	E	H			T,H	163	90/100 I
Ceratotherium	simum												
Ceratotherium	s. cottoni	Zaire, Sudan (?)	31	1	I	A	C	H		Y	H	10	NUC II
Ceratotherium	s. simum	S.Africa, Zimbabwe, Kenya	5,560	6	I	A	V	H,L				570	90/100 I
Rhinoceros	unicornis	India, Nepal	1,700	10	S	A	E	L,H	Y			120	90/100 I
Rhinoceros	sondaicus												
Rhinoceros	s. annamiticus	Vietnam	<25	2	D	A	C	H			S	0	
Rhinoceros	s. sondaicus	Java (Indonesia)	<75	1	S	A	C	L,H		Y		0	
Dicerorhius	sumaterensis												
Dicerorhinus	s. harrisoni	Kalimantan, Sabah, Sarawak	100	3	D	AA	C	L,H			T,S	2	90/100 I
Dicerorhinus	s. lasiotus	Burma (?)	?	?	D	A	C	L,H			S	0	
Dicerorhinus	s. sumatrensis I	Peninsular Malaysia	150	4	D	A	C	L,H			T,S,H	8	90/100 I
Dicerorhinus	s. sumatrensis II	Sumatra (Indonesia)	600	3	D	AA	E	L,H			T,S,H	13	90/100 I

Refer to Section 13 for an explanation of the column categories.

T.J. Foose
15 June 1992

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**	**?**

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TABLE 3
STRATEGIC SUPPORT OF *IN SITU* PROTECTED AREAS FOR RHINO BY THE GLOBAL AND REGIONAL CAPTIVE COMMUNITIES

TAXON	NUMBER OF SIGNIFICANT *IN SITU* SANCTUARIES	SUPPORTED BY ZOOS FROM					
		AFRICA	ASIA	AUSTRALASIA	EUROPE	N. AMERICA	S. AMERICA
Eastern Black	7				3	2+ ?	
Southern Black	7			1		1 ?	
Southwestern Black	2						
North/West Black	?						
Northern White	1				1		
Southern White	5						
Indian/Nepali	6					1	
Javan (Java)	2					1	
Javan (Vietnam)							
Mainland Sumatran	2						
Sumatra Sumatran	3						
Borneo Sumatran	4						
African Rhino	**20**						
Asian Rhino	**20**						
All Rhino Taxa	**40**						

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TABLE 4
ANNUAL COSTS FOR CONSERVATION OF VIABLE POPULATIONS OF RHINO

TAXON	TARGET POPULATION	DENSITY (km/rhino)	AREA (km^2) REQUIRED	COST per km^2	ANNUAL COST
N. Black	2,000	3	6,000	$400	$2,400,000
S. Black	2,000	3	6,000	$400	$2,400,000
S.W. Black	2,000	3	6,000	$400	$2,400,000
N.W. Black	2,000	3	6,000	$400	$2,400,000
N. White	2,000	1.5	3,750	$400	$1,500,000
S. White	2,500	1.5	3,750	$400	$1,500,000
Indian/Nepali	2,500	0.5	1,250	$250	$300,000
Borneo Sumatran	2,000	10	20,000	$100	$2,000,000
Sumatra Sumatran	2,000	10	20,000	$100	$2,000,000
Mainland Sumatran	2,000	10	20,000	$100	$2,000,000
Javan	2,500	5	12,500	$100	$1,250,000
TOTALS	**23,500.00**	**50.50**	**105,250.00**	**$3,050.00**	**$20,150,000.00**

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TABLE 5
RHINO INSTITUTIONS

TAXON	WORLD	AFRICA	ASIA					AUSTRALASIA	EUROPE	N.A.	S.A.
			CHN	IND	JPN	S.E.	M.E.				
Eastern Black	55	3	2	3	4	1	1	1	11	24*	4
Southern Black	14	1	0	0	1?	0	0	1	2	9	0
Southwestern Black	0	0	0	0	0	0	0	0	0	0	0
North/West Black											
Northern White	2	0	0	0	0	0	0	0	1	1	0
Southern White	215 **	12	6	3	23	6	6	6	87	45*	21
Indian/Nepali	45 *	0	1	12	3	1	0	0	14	13*	1
Mainland Sumatran	2	0	0	0	0	1	0	0	0	0	0
Sumatra Sumatran	8	0	0	0	0	5	0	0	1	4	0
Borneo Sumatran	1										
Javan (Java)	0	0	0	0	0	0	0	0	0	0	0
Javan (Vietnam)											
African Rhino	**266**	**16**	**8**	**5**	**29**	**6**	**8**	**7**	**95**	**70**	**23**
Asian Rhino	**52**	**0**	**1**	**12**	**3**	**5**	**0**	**0**	**15**	**11***	**1**
All Rhino	**290 *****	**16**	**8**	**13**	**30**	**7**	**8**	**7**	**101**	**74***	**23**

* San Diego Zoo & San Diego Wild Animal Park = 1 Institution
** 139 of the white rhino institutions maintain ≤ 2 individuals
*** ~ 200 "Hard Currency" Zoos with rhinos
~ $ 1 billion annual operation budgets

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TABLE 6
DEMOGRAPHIC PERFORMANCE OF GLOBAL AND REGIONAL POPULATIONS OF RHINO IN CAPTIVITY

	WORLD		AFRICA		ASIA		AUSTRALASIA		EUROPE		N. AMERICA		S. & C. AMERICA	
TAXON	λ		λ		λ		λ		λ		λ		λ	
	HIST	81-92	HIST	81-92	HIST	81-92	HIST	81-92	HIST	81-92	HIST	81-92	HIST	81-92
E. Black	.97	.97	-	-	.94	.9	-	-	.96	.98	.97	.99	-	-
E. Black Core											1.02	1.03		
S. Black	< 1	< 1	-	-	-	-	-	-	-	-	< 1	< 1	-	-
S.W. Black	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N.W. Black	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. White	0	0	0	0	-	-	-	-	-	-	-	-	-	-
S. White	?	?	?	?	?	?	?	?	?	?	< 1	< 1	?	?
Indian/Nepali	1.02	1.02			1	.98			1.04	1.02	~ 1	1.03	-	-
Javan (Javan)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Javan (Viet.)														
M.Sumatran	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.Sumatran	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B.Sumatran	-	-	-	-	-	-	-	-	-	-	-	-	-	-

λ < 1 = decreasing population
λ = 1 = stationery population
λ > 1 = increasing population
e.g. 1.02 = 2% increase/year
.97 = 3% decrease/year

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15 June 1992

TABLE 7
GENETIC COMPOSITION
IN TERMS OF FOUNDERS OF
GLOBAL AND REGIONAL POPULATIONS OF
RHINO IN CAPTIVITY

	WORLD		AFRICA		ASIA		AUSTRALASIA		EUROPE		N. AMERICA		S. & C. AMERICA	
TAXON	FOUNDERS		FOUNDERS		FOUNDERS		FOUNDERS		FOUNDERS		FOUNDERS		FOUNDERS	
	#	Unq	#	Unq	#	Unq	#	Unq	#	Unq	#	Unq	#	Unq
E. Black	95	80	7	7	24	15	3	3	36	25	44	26	9	4
S. Black	38	38	4	4	2	2	0	0	4	4	28	28	0	0
S.W. Black														
N/W Black														
N. White	7	4	0	0	0	0	0	0	4	1	4	3	0	0
S. White	> 100	0	?	?	?	?	?	?	?	?	99	?	?	?
Indian/Nepali	62	44	0	0	38	22	0	0	14	6	26	16	3	0
Javan (Java)														
Javan (Viet.)														
M.Sumatran	8.5	8.5	0	0	8.5	8.5	0	0	0	0	0	0	0	0
S.Sumatran	15	15	0	0	7	7	0	0	2	2	6	6	0	0
B.Sumatran	3	3	0	0	3	3	0	0	0	0	0	0	0	0

# = Number of Potential Founders
Unq = Founders Unique to Region

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15 June 1992

TABLE 8
GENETIC COMPOSITION
IN TERMS OF FOUNDER GENOME EQUIVALENTS
OF GLOBAL AND REGIONAL POPULATIONS OF
RHINO IN CAPTIVITY

	WORLD		AFRICA		ASIA		AUSTRALASIA		EUROPE		N. AMERICA		S. & C. AMERICA	
TAXON	F.G.E.		F.G.E.		F.G.E.		F.G.E.		F.G.E.		F.G.E.		F.G.E.	
	A	P	A	P	A	P	A	P	A	P	A	P	A	P
E. Black	30	80	1	5	8.3	21	1	2	14.8	24.9	15	32	1	4.5
S. Black	11	34	50	87.5	50	75	0	0	2	4	8	24.5	0	0
S.W. Black														
N/W Black														
N. White	2	7	0	0	0	0	0	0	2	3.4	0	4	0	0
S. White			?	?	?	?	?	?	?		18	97	?	?
Indian/Nepali	7	55	0	0	4.9	34.5	0	0	3.7	9.4	5.7	20	1	0
Javan (Java)														
Javan (Viet.)														
M.Sumatran	.5	8.5	0	0	0	8.5	0	0	0	0	0	0	0	0
S.Sumatran	0	15	0	0	0	7	0	0	0	2	0	6	0	0
B.Sumatran	0	3	0	0	0	3	0	0	0	0	0	0	0	0

F.G.E. = Founder Genome Equivalents
A = Actual
P = Potential

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15 June 1992

TABLE 9
GENETIC COMPOSITION
IN TERMS OF GENE DIVERSITY OF
GLOBAL AND REGIONAL POPULATIONS OF
RHINO IN CAPTIVITY

	WORLD		AFRICA		ASIA		AUSTRALASIA		EUROPE		N. AMERICA		S. & C. AMERICA	
TAXON	GENE DIVERISTY		GENE DIVERSITY		GENE DIVERSITY		GENE DIVERSITY		GENE DIVERSITY		GENE DIVERSITY		GENE DIVERSITY	
	A	P	A	P	A	P	A	P	A	P	A	P	A	P
E. Black	98.3	99.4	50	92.9	94	97.6	50	0	96.6	98	96.7	98.4	50	89
S. Black	95.1	98.5	0	87.5	50	50	0	0	75	87.5	93.8	98	0	0
S.W. Black														
N.W. Black														
N. White	75	92.9	0	0	0	0	0	0	71.5	85.3	0	87.5	0	0
S. White	99	99	?	?	?	?	?	?	?	?	96.5	99.5	?	?
Indian/Nepali	92.8	99	0	0	89.7	98.6	0	0	86.5	94.7	91.2	97.5	50	0
Javan (Java)														
Javan (Vietnam)														
M.Sumatran	0	94.1	0	0	0	94.1	0	0	0	0	0	0	0	0
S.Sumatran	0	96.7	0	0	0	96.7	0	0	0	0	0	91.7	0	0
B.Sumatran														

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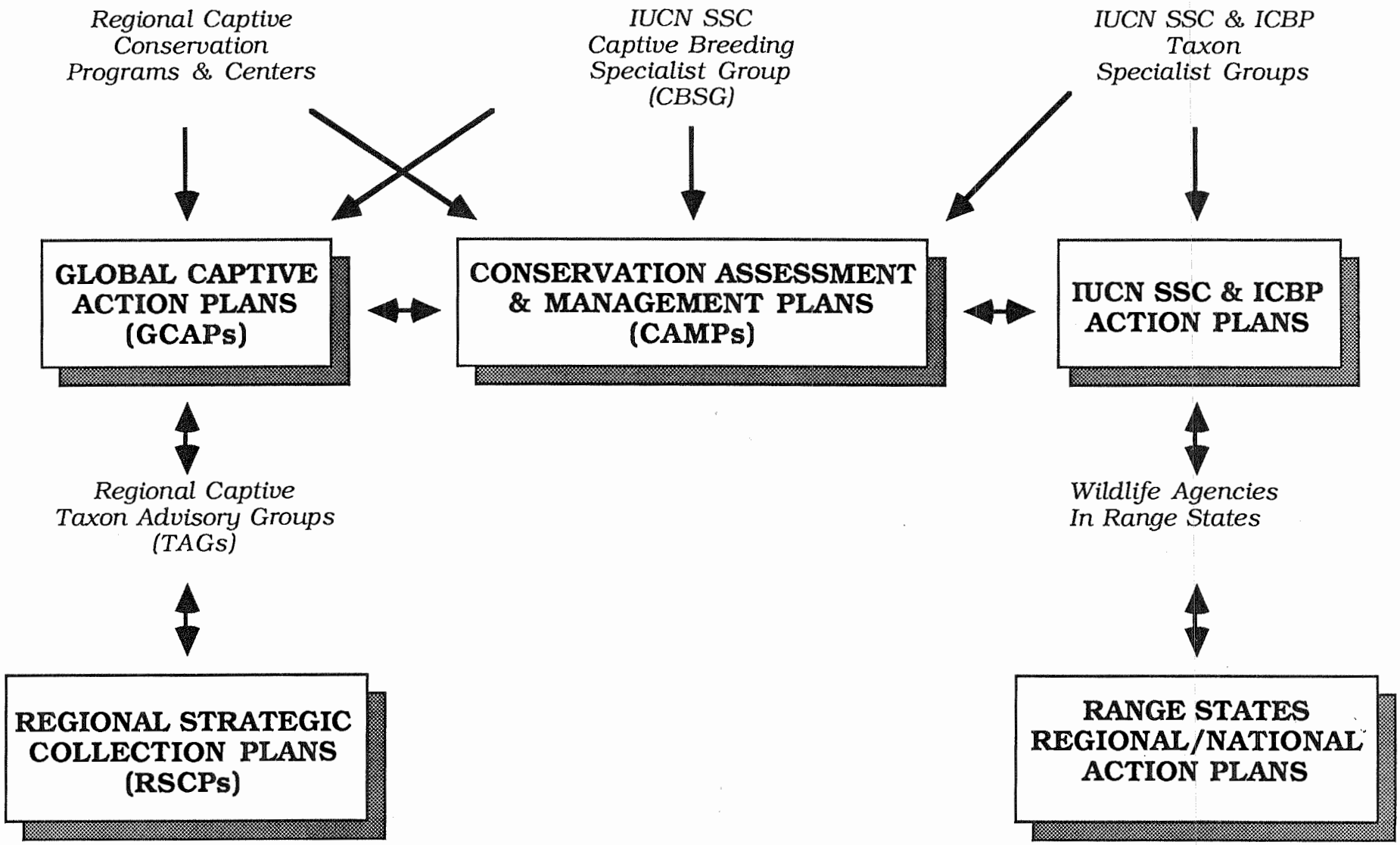
15 June 1992

TABLE 10
MACE/LANDE CATEGORIES AND CRITERIA OF THREAT

POPULATION TRAIT	CRITICAL	ENDANGERED	VULNERABLE
Probability of Extinction	50% within 5 years or 2 generations, whichever is longer	20% within 20 years or 10 generations whichever is longer	10% within 100 years
	Or	**Or**	**Or**
	Any 2 of following criteria	Any 2 of following criteria or any 1 CRITICAL criterion	Any 2 of following criteria or any 1 ENDANGERED criterion
Effective Population N_e	$N_e < 50$	$N_e < 500$	$N_e < 2{,}000$
Total Population N	$N < 250$	$N < 2{,}500$	$N < 10{,}000$
Subpopulations	≤ 2 with $N_e > 25$, $N > 125$ with immigration < 1/gen.	≤ 5 with $N_e > 100$, $N > 500$ or ≤ 2 with $N_e > 250$, $N > 1{,}250$ with immigration < 1/gen.	≤ 5 with $N_e > 500$, $N > 2{,}500$ or ≤ 2 with $N_e > 1{,}000$, $N > 5{,}000$ with immigration < 1/gen.
Population Decline	> 20%/yr. for last 2 yrs or > 50% in last generation	> 5%/yr. for last 5 years or > 10%/gen. for last 2 gens.	> 1%/yr. for last 10 years
Catastrophe: Rate & Effect	> 50% decline per 5-10/yrs or 2-4 gens.; subpops. highly correlated	> 20% decline/5-10 yr, 2-4 gen > 50% decline/10-20 yrs, 5-10 gen. with subpops. correlated.	> 10% decline/5-10 yrs, > 20% decline/10-20 yrs, or > 50% decline/50yrs. with subpops. correlated.
Or			
Habitat Change	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects
Or			
Commercial Exploitation or Interaction/Introduced Taxa	resulting in above pop. effects	resulting in above pop. effects	resulting in above pop. effects

FIGURE 1

GLOBAL AND REGIONAL STRATEGIC CONSERVATION ACTION PLANS



T.J.F./CBSG
1 August 1992

FIGURE 2

GLOBAL CAPTIVE PROPAGATION AND MANAGEMENT GROUP

CHAIR: T.J. Foose, CBSG Executive Office (Pro Tem)

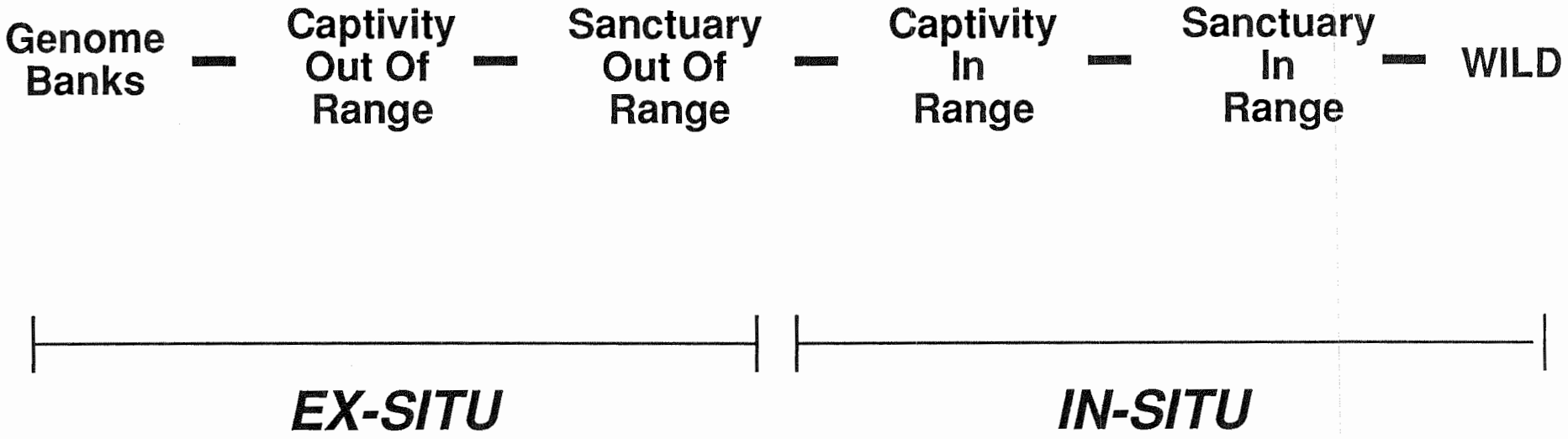
REGIONAL COORDINATORS:

		African			Asian		
	TAG	**Black**		**White**	**Indian/Nepali**	**Sumatran**	**Javan**
Africa (PAAZAB, ZDNAPWM, KWS)		V. Wilson M. Kock R. Brett					
Asia							
Japan (SSCJ)	M. Masui	Otsu					
India (IESBP)			(To be Appointed by the Central Zoo Authority of India)				
S.E. Asia (SEAZ)					B. Harrison	Tajuddin Jansen M.	
Australasia (ASMP)		J. Kelly		P. Garland		D. Miller (All Asian)	
Europe (EEP/JMSG)		R. Frese	A. Dixon N. Lindsay (UK)	K. Tomasova	K. Tobler	C. Furley	
North America (AAZPA SSP)	R.Reece	E. Maruska D. Farst J. Jackson		R. Rockwell	M. Dee	J. Doherty J. Dolan	

Advisors: M. Brooks — Chairman, African Rhino Specialist Group; M. Khan — Chairman, Asian Rhino Specialist Group; N. Van Strien; G. Amato; O. Ryder; B. Dressser; E. Miller

FIGURE 3

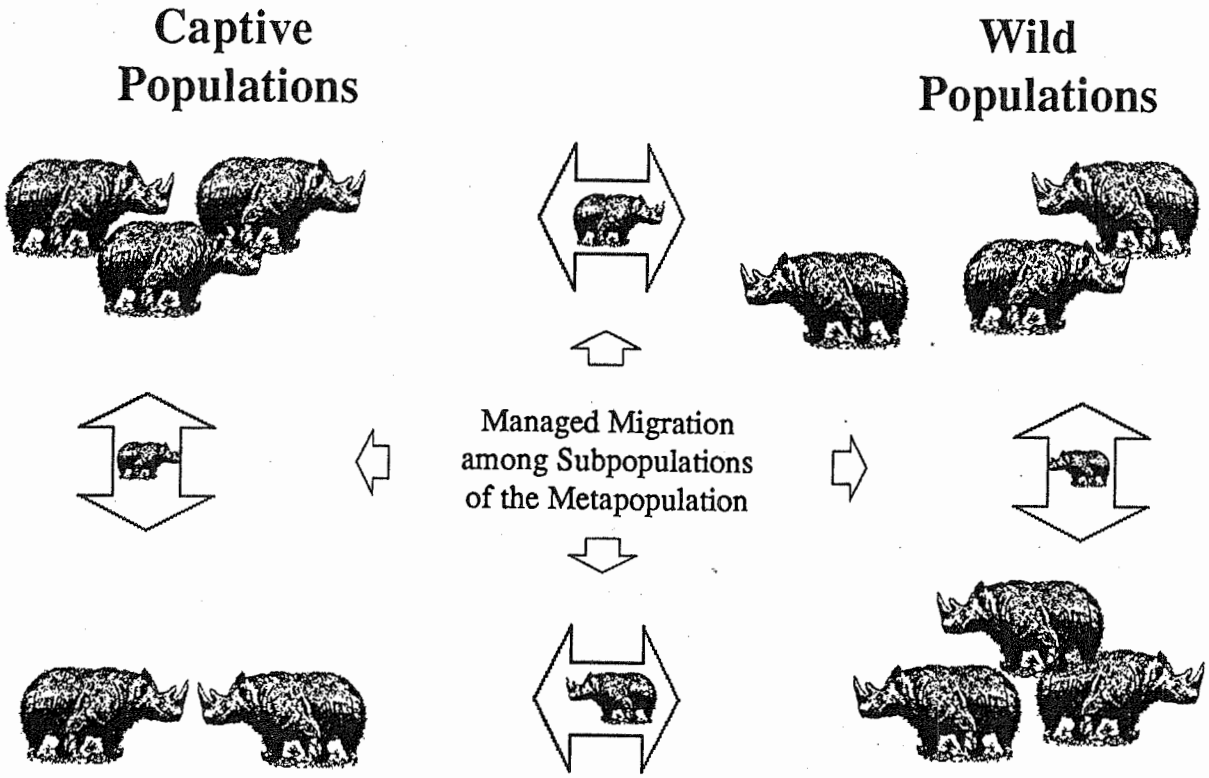
OPTIONS FOR RHINO CONSERVATION



Modified from Mark Stanley-Price (1991)

FIGURE 4

Metapopulation



RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 2

BLACK RHINO

BLACK RHINO WORKING GROUP

Working Group: *(Chairperson) Reinhard Frese, (Recorder) Bruce Read, Christian R. Schmidt, Mitsuko Masui, Charlie Hoessle, Koen Brouwer, Betsy Dresser, Vivian Wilson, Alexandra Dixon, Jim Jackson, Simon Wakefield & Kristina Tomasova*

Goal: Establish target captive populations for four geographic areas 1) Africa 2) Austral-Asia 3) Europe 4) Americas.

Facts: When reviewing the age structure of the captive population in the studbook we observe that we have an aging population that has most of the reproduction in the founder and 1st generation.

Data: Michaeli

Living Population

75 Males
94 Females

Surviving Active Breeding Animals (1987-1990)

11 Males (born between 1956-1981)
21 Females (born between 1961-1982)

Animals kept in institutions with out the opposite sex.

7 Males
6 Females (between 6-25yrs of age + 2 over 25yrs)

Post Reproductive Animals (assumption that female on the average stop reproducing at 25 yrs of age)

- Males (can breed until they die)
16 Females over the age of 25 yrs.

Pre Reproductive Animals (animals under 6 years of age)

20 Males
20 Females

Result:

1) Of the 94 females in the population 31 females are of reproductive age and are at institutions with males, but are not reproducing. Therefore, not contributing to the gene pool.

2) Of the 75 males 37 are old enough to breed and are not contributing to the gene pool.

Mortality/Births

Year	1987	1988	1989	1990	Total
Births	2	7	8	7	24
Deaths	5	5	6	7	23

0-6	9/39%
6-25	7/30%
26+	7/30%

Target Goal: To increase the recruitment rate and carrying capacity of the captive population through: 1) increasing the birth rate; 2) enlarging the number of holding facilities; 3) increasing the holding space at existing facilities.

Recommendations:

1) A target captive population for Michaeli of 200 animals globally in the four geographic regions.

   Support for this recommendation: a) By adding the additional females to the breeding population (31 and 6) we are estimating that 1/2 of these will begin to produce offspring. The rate of mortality of the youngest age group was kept at 39%. This doubled the rate of recruitment; b) By breeding females at the age of 3-4 yrs we have lowered the average age of reproduction and c) By shortening the birth interval we have increased the number offspring produced.
   Effective size of 20 - Lambda of .05 - generation length 13 - program length 100 yrs. (reflect the ratio of .3 if the ratio is .2 we are looking at a population of 250).

   Goals: a) increase the number of breeding animals; b) increase the number of births per lifetime; c) manage for equal family size; d) achieve target founder representation.

2) A target captive population for Minor of 125 animals globally in three regions (Africa, Australia and North America).

   Support for this recommendation: a) All the animals that are in the captive population are in the age bracket for potential reproduction or younger and will soon be in this age bracket; b) This population is just being formed and can learn from the problems of the existing East African rhino population; c) The wild population is larger than the East African one. Effective size of 20 - Lambda 1.03 - generation length 15 - program length 100 yrs. (123 reflects a ratio of .3 if the ratio is .2 we are looking at a population of 185).

   Goals: a) increase the captive population size by recruitment from the wild and increased birth rate; b) achieve target founder representation; c)

Recommendation for implementation:

1) Look at the possibilities of expanding the captive holding space by: a) increase the number of animals held at each breeding institution; b) expand the total number of holding and breeding facilities in the four geographic areas; c) encourage those institutions that have open holding space to move animals in; d) to utilize unsuitable white rhino space for black rhino.

2) Increase the recruitment rate by: a) pairing up single animals (for example the single female in Rome); b) place young (3 yr old) females in breeding situations; c) shorten the birth intervals of producing females (two - four years); d) identify and evaluate female in reproductive situations that are not reproducing.

3) It is essential to move all 31 presently non breeding females and 6 isolated females into a breeding situation.

4) Of the 7 isolated and 37 presently non reproductive males it is a priority to identify the potential founder animals and transfer them into a breeding situation.

5) Micheali should be kept in Africa, Asia (excluding Australia), North America, South America & Europe.

6) Minor should be kept in Africa. Australia & North America.

7) All regional coordinators should cooperatively establish guidelines for captive management of black rhino within their region.

8) All potentially reproductive animals need to be brought in the breeding nucleus. If this effort is not effective this population will not stabilize and will become extinct.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 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.

Recommendations: (Captive Population)

1. **Action Plan.**

   A. Identify people to assist current population and to develop an action plan. (Robert Reece, Tom Foose, Larry Kilmar, Christina Thomasova, Nick Lindsey). 90 Days!

Status of Northern White Rhinoceros: Action Needs for the Captive Population

Working Group: *O. Ryder, R. Reece, T. Foose*

The senescent age structure of the captive population as well as the limited number of founders that have reproduced forecast an imminent extinction of this population.

Urgent priorities for reproductive and genetic research have been identified. Additionally, the development and implementation of a detailed action plan has been recognized as a necessary response to the declining status of the captive population for several years. However, as yet, no implementation has occurred.

From the perspective of the conservation of this unique form of rhino and the involvement of the captive population in reinforcing a global conservation plan, the potential of the captive population must be realistically assessed with urgency.

If, within the next 12 months, no positive results have been achieved in reproductive enhancement or gamete preservation involving the captive population, then the world community must recognize that the captive population will not contribute to the conservation of the northern white rhinoceros. While this will inevitably fuel criticism of *ex situ* conservation efforts for rhinos in particular, acknowledgement of the reality of the situation will allow for alternative or redesigned strategies to proceed. Translocation of animals that have reproductive potential into *in situ* reserves either in Zaire or newly created reserves within the historic range are examples of redesigned strategies.

The urgent priorities for making the captive populations of northern white rhinoceros responsive to the global conservation strategy for this unique form of rhinoceros are:

(1) Development of a captive action plan that incorporates identified research needs into the programs at the zoos maintaining the northern white rhinoceros. The chair of the action plan group should immediately identify technical advisors to assist in the preparation of the detailed plan (suggested: Ryder, Hodges, Dresser, Schaffer, others to be named). Produce budgets for identified activities.

(2) Produce a Memorandum of Understanding under the auspices of the IUCN/CBSG global white rhino coordinator to be signed by the directors of Zoological Society of San Diego and Vychodoceska Zoo (Dvur Kralove) that recognizes the activities of the northern white rhinoceros captive action plan group and provides assurances of cooperation.

(3) Appointment of a person to be in charge of collecting and interpreting the available reproductive data (suggested: Hodges).

(4) Assemble and distribute protocols for collection, storage and shipment of necessary biological samples.

(5) Collect and freeze semen according to optimized protocols from all males held in captivity. Query the Vychodoceska Zoo and San Diego Zoo concerning any cryopreserved sperm. Both have made sperm collections. Determine the status of these samples. Arrange for the long term storage at multiple sites.

(6) Develop a detailed research program with the goal of achieving the capability to conduct embryo transfer of northern white rhinoceros to southern white rhinoceros females within a 3-5 year period. Produce budgets for same.

(7) Provide regular communication to CBSG, ARSG and other appropriate bodies concerning the ongoing developments.

(8) Explore options for translocation to protected and managed areas in Africa within the historic range.

NORTHERN WHITE RHINOCEROS (Ceratotherium simum cottoni)
PARC NATIONAL DE LA GARAMBA
POPULATION STRUCTURE AND DYNAMICS, APRIL 1992

ADULT MALES:		STATUS:
M2	'Eleti'	dominant, territory changed in 09.88.
M3	'Kondo akatani'	prior to 09.88 classed as old sub-adult, took over territory of M2.
M4	'Bac'	probably dominant.
M5	'Bawesi'	dominant
M6	'Longuecorne'	dominant
M7	'Moitier'	young male
M9	'Notch'	dominant

ADULT FEMALES:		
F1	'Mama Moke'	with JF
F3	'Kunalina'	with JM
F4	'Boletina'	with IF
F5	'Mama Giningamba'	with JM
F6	'Pacque'	with JM and SP
3aF	'Kuni'	born c.9-10/83, with JM

SUB-ADULTS:		
1aM	'Moke'	S2, male, born mid 1983
4aM	'Bolete moke'	S2, male, born c. 08-09.1983
5aM	'Giningamba'	S2, male, born 02.85
4bF	'Mai'	S2, female, born 05.85
3bF	'Juillet'	S2, female, born 07.85,
6aF	'Oeuf de Pacque'	S1, female, born 03.86
4cF	'Noel'	S1, female, born 10-11.87
5bF	'Grizmek'	S1, female, born 10.87
6bM	'Elikya'	S1, male, born 06.88
1bM	'Mpiko'	S1, male, born 03-04.89

JUVENILES:		
4dF	'Minzoto'	J3, female, born 08-09.89
5cM	'Molende'	J3, male, born 08.89
3cM	'Solo'	J3, male, born 12.89
3aaM	'Bonne Annee'	J2, male, born 12.90
1cF	'Nawango'	J2, female, born 02.91
5dF	'Jengatu'	J1, female, born 07.91 (M3 sire?)
3dM	'Mamu'	J1, male, born 09.91
4eF	'Sifa'	I2, female, born 01.92

TOTAL KNOWN INDIVIDUALS:	
Male adults (MA)	7
Female adults (FA)	6
Males sub-adults (SM)	5
Female sub-adults (SF)	5
Male juveniles (JM)	4
Female juveniles (JF)	3
Female infant (IF)	1
TOTAL	31
SEX RATIO	16M : 15F
ADULT:SUBAD & JUV.RATIO	1 : 1.4

(Kes Smith)

NORTHERN WHITE RHINO Studbook

(Ceratotherium simum cottoni)

Restricted to:

Status: Living by 1 Sep 1992

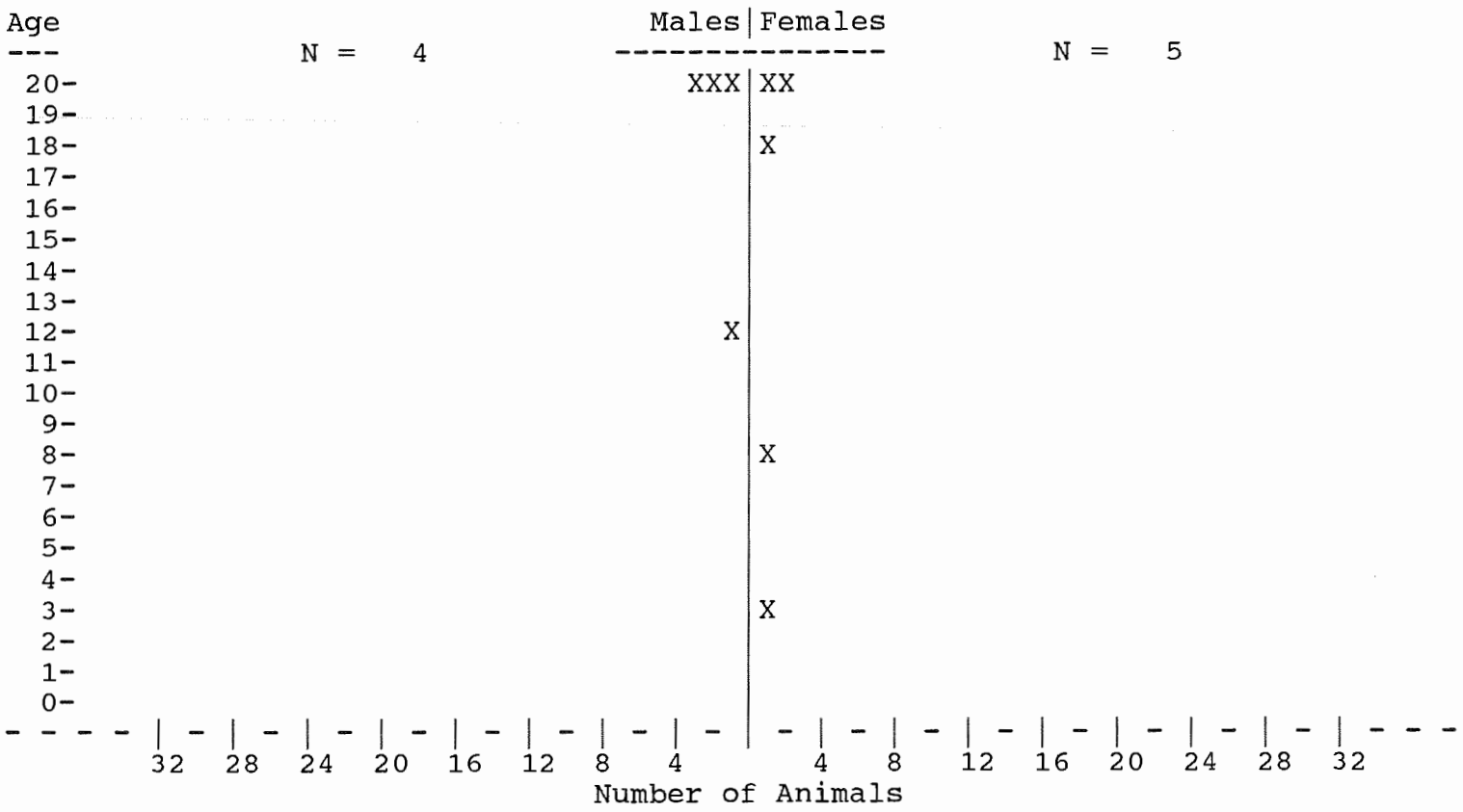
Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Birth-Origin	Country	Breeder #
348	M	1 Jan 1972	WILD	WILD	SUDAN	1 Apr 1973	UNK	Wild Born	SUDAN	KHM 04
					SD-WAP	12 Aug 1990	UNK		U.S.A.	
372	M	1 Jan 1972	WILD	WILD	SUDAN	19 Jun 1975	UNK	Wild Born	SUDAN	DVU 12
					DVURKRALV	19 Sep 1975	UNK		CZECHOSLO	
373	M	1 Jan 1972	WILD	WILD	SUDAN	19 Jun 1975	UNK	Wild Born	SUDAN	DVU 13
					DVURKRALV	19 Sep 1975	UNK		CZECHOSLO	
					SD-WAP	14 Oct 1989	UNK		U.S.A.	
374	F	1 Jan 1974	WILD	WILD	SUDAN	19 Jun 1975	UNK	Wild Born	SUDAN	DVU 14
					DVURKRALV	19 Sep 1975	UNK		CZECHOSLO	
					SD-WAP	14 Oct 1989	UNK		U.S.A.	
376	F	1 Jan 1972	WILD	WILD	SUDAN	19 Jun 1975	UNK	Wild Born	SUDAN	DVU 16
					DVURKRALV	19 Sep 1975	UNK		CZECHOSLO	
					SD-WAP	14 Oct 1989	UNK		U.S.A.	
377	F	1 Jan 1972	WILD	WILD	SUDAN	19 Jun 1975	UNK	Wild Born	SUDAN	DVU 17
					DVURKRALV	19 Sep 1975	UNK		CZECHOSLO	
630	M	8 Jun 1980	373	351	DVURKRALV	8 Jun 1980	UNK	Captive Born	CZECHOSLO	DVU 22
789	F	15 Nov 1983	372	351	DVURKRALV	15 Nov 1983	UNK	Captive Born	CZECHOSLO	DVU 23
943	F	11 Jul 1989	372	351	DVURKRALV	11 Jul 1989	UNK	Captive Born	CZECHOSLO	DVU 24

TOTALS: 4.5.0 (9)

Age Pyramid Report

Restricted to: NORTHERN WHITE RHINO Studbook
Status: Living by 1 Sep 1992

Taxon Name: **CERATOTHERIUM SIMUM COTTONI**



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

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 4

INDIAN/NEPALI RHINO

INDIAN/NEPALI RHINO WORKING GROUP

Working Group: *(Chairman) Michael Dee, Kathleen Tobler, B. G. Mugadur, Prof. M. V. Subba Rao, Dr. Tuhin Chakraborthy, Sally Walker*

CAPTIVE POPULATION

At the present time the population of this species is increasing at a rate of (roughly) 3 per cent per year. We would like to bring it up to 5 per cent per year so that the goal of 90 per cent heterozygosity can be maintained over a period of 100 years. The population will need to increase to 228 animals in order to reach this goal.

There are 45 known institutions that maintain this species. The majority of these institutions (37) are located on three continents: N. America (13), Europe (13) and India (11). Of these institutions, 22 have had successful breeding: N. America (7); Europe (8), and India (7 known for sure).

In the captive world population there are 120 animals (71:49). Of those which have not bred, 18 are females under breeding age and 34 are males under breeding age. Some of these underaged animals are in pair situations and should breed at some point in the future. Of the total number 11 are single males.

Referring back to the figure of 228 animals which would be necessary to preserve 90% heterozygosity for 100 years, with the present reproducing females (30) plus the 18 juveniles which should reproduce within the next five years, we can project a minimum of 14 calves per year. By these calculations we can assume that the population of 228 animals can be achieved in 12 to 14 years.

According to the above figures a total of 18 new captive breeding situations need to be created. Of the zoos in the two continents (i.e. N. America and Europe) and the Asian region (i.e. India, Japan, Singapore, Nepal) there are a total of 27 institutions which are potentially likely candidates for taking up a captive propagation programme.

North America -- 7 Europe -- 6 Asian Region -- 14

With the current captive population this number could increase by 42 animals every three years if managed properly. This would give us our goal of 228 animals in ten years.

Projected births

North America -- 15 Europe -- 12 Asian Region -- 15

Target Population Totals

North America -- 75 Europe -- 75 Asian Region -- 78

With reference to the situation of zoos in India, there is a surfeit of males to females. There is, however, a source of additional female calves which are moved to the Assam State Zoo from the wild as a result of rescue operations during monsoon. Unfortunately, these calves are in a debilitated condition when rescued and frequently do not survive long after reaching the zoo. The Working Group considered some assistance to the Assam State Zoo in locating references and information on the care and treatment of stressed animals might be useful. It may well be that a protocol for such treatment would have to be developed. The Working Group suggested that Dr. Suzie Jackson who is coordinating the Wildlife Veterinary and Animal Husbandry Information Network be consulted on this issue by C.B.S.G., India/Zoo Outreach Organisation.

It is likely that a Special Interest Group for Indian rhino may be formed under the auspices of C.B.S.G., India. The working group endorses this endeavor and requests this group or CBSG, India until it forms to act as liaison for the various initiatives discussed in this document.

WILD POPULATIONS

According to the Asian Rhino Action Plan, compiled by Mohammed Khan, Chairman, IUCN/SSC Asian Rhino Specialist Group, there are several protected areas in India that have very small populations of Indian rhinos Laokhowa 5, Orang 65, Pobitara 40, Manas 80, Dudhwa 7. In addition there are two protected areas in West Bengal, Jaldapara 35-45 and Gurumara 11.

There is also one such population in a protected area, Royal Bardia in Nepal with about 40 animals, a great percentage of which were translocated from Chitwan National Park. However, breeding has been successful in Bardia.

It is recommended that these small protected areas be recognized and included in the list for potential sponsorship by western zoos under an Adopt a Park programme. All of these are candidates for intensive management that would include technical training, marking equipment, radio telemetry equipment, research (including genetic studies) etc. as well as grass roots education programmes, anti-poaching programme and habitat restoration. It is possible that a zoo or group of zoos with limited resources could take up one of these areas.

It is further recommended that a P.H.V.A. Workshop and International Symposium be conducted under the joint auspices of the Asian Rhino Specialist Group, the Captive Breeding Specialist Group assisted by CBSG India, the Government of India, and the Government of West Bengal in Jaldapara Sanctuary for Indian rhino be held in Jaldapara Sanctuary as early as possible, preferably no later than 1993. In addition to creating a Action Plan for each population the P.H.V.A. will serve the purpose of drawing attention to the importance of this and other small populations. This will have the additional benefit of strengthening the hand of the local, state and central forest and environmental authorities in obtaining funding and help from international aid agencies.

The two protected areas with relatively large populations still continue to be plagued by poaching, natural calamities, etc. These areas would also be excellent candidates for sponsorship programmes on a larger scale.

The present Chief Wildlife Warden of West Bengal was contacted in January 1992 and after the Workshop and a discussion held on the subject of a P.H.V.A. in Jaldapara. He is very much in agreement that such a Workshop may be useful and feasible but would like more detail regarding the long range strategy and significance of such a workshop and assurance that the Rhino Specialist Group would be involved. The Working Group suggests that Dr. George Rabb, Mr. Moh'd Khan, or Dr. U.S. Seal should address these issues with Mr. Dey. The Working Group also feels that financial assistance will be needed and should be provided to the Government of West Bengal for this workshop.

List of Invitees from India should include:

Indian representatives of the Asian Rhino Specialist Group.

Representatives from the Official Forest and Wildlife Establishment, i.e. Secretary to Government, MOEFWL, Inspector General for Forests, Addl. I. G. (Wildlife), Jt. Directors (Wildlife), MOEFWL, Regional Dy. Director (WL), Eastern and Northern Region, Chief Wildlife Wardens of states with rhinos populations, Representatives from the Wildlife Institute of India.

Representatives from the Captive Breeding community, i.e. the Zoo Authority of India, the Indian Zoo Directors' Association, Directors and Veterinary doctors of zoos presently holding rhinos as well as zoos selected by the Zoo Authority of India to take up a rhino breeding programme, Principle Investigator, Zoo Consultancy Project, Wildlife Institute of India.

Representatives from various governmental and non-governmental research, education, and conservation organizations, i.e. CBSG, India, Zoological Survey of India, Worldwide Fund for Nature, Zoo Outreach Organization, Botanical Survey of India and active group from the states of Assam, West Bengal and Uttar Pradeh.

The working group recommends that CBSG, India or the Indian Rhino Special Interest Group when it forms act as liaison to initiate and coordinate the PHVA until required governmental permissions can be obtained and the Department of Forest, Government of West Bengal can take over.

Education/Awareness

The Indian zoo, wildlife and conservation community should use the opportunity of this P.H.V.A. to highlight the importance of the rhino as a symbol of endangered species as well as to focus on the smaller protected areas. A comprehensive Education Programme using the Indian rhino and rhino habitat as its focus is recommended. Zoos in other parts of the world may be interested in a collaborative support project for such educational endeavors.

Note of Dudhwa Reintroduction

The working group is aware of the reintroduction of Rhino into Dudhwa National Park and subsequent breeding successes. We acknowledge this effort as major stride in rhino conservation. The group is also aware that a single male has sired all of the offspring which have been bred so far and that the authorities in India share our concern over the question of genetic representation. Since obtaining a male from the wild is problematic, and since there are surplus males in the Kanpur Zoo in the same state, it may be advisable to consider introducing a captive born male into Dudhwa at least temporarily to provide addition genetic potential. The technical problems arising from such an experiment are fully acknowledged and the Workshop should make a commitment toward providing any advice, help and expertise which may be requested by the Indian wildlife authorities for this project.

Note on Wildlife Protection Act Amendments and Zoo Act

The Working Group is aware that the Government of India recently passed Amendments to the Indian Wildlife (Protection) Act 1972 which imposes far stricter penalties for poaching.

Also included in the Amendments Bill was a comprehensive body of legislation entitled the Indian Zoo Act which has resulted in the setting up of a Zoo Authority of India that will effectively ensure that endangered species of animals in zoos are maintained in breeding groups.

The working group felt that the Workshop should include in their report an endorsement or congratulatory note on these very constructive initiatives.

The Working Group respectfully recommends that the Zoo Authority of India, when formulating an organised captive breeding strategy for Indian zoos, appoint a Species Coordinator for Indian rhinos who would be responsible for monitoring activities regarding this species in all the zoos and generally looking after its interests in all respects. The Species Coordinator could be the Regional Studbook Keeper or any other interested person. Zoo Outreach Organisation will circulate information to the Zoo Authority about various Species programmes around the world.

Note of Project Elephant

The working group is aware of the recent initiative of the Government of India to carry out a Project Elephant. We hope that in course of time a similar initiative might be launched for the Greater One-horned Asian Rhino.

Note on zoo space

The working group felt it should be noted that there are a number of captive facilities in India consisting of several hundred acres of forested area in isolated locations relatively near the natural habitat of rhino. The Indian Forest establishment should be acknowledged for having the

foresight to set aside these areas. These facilities would contribute substantially -- both qualitatively and quantatively -- to the total amount of potential captive space in the global zoo community. For large species such as rhinos these areas may be useful both for extensive captive breeding programmes as well as acclimatization for introduction or reintroduction activities.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 5

SUMATRAN - JAVAN RHINO

SUMATRAN-JAVAN RHINO WORKING GROUP

Working Group: *(Chair) R. Tilson, M. Khan, N. Van Strien, J. Manansang, M. Hutchins, P. Wells*

I. Taxa To Be Bred In Captivity

(1) Sumatran
(2) Bornean
(3) Peninsular Malaysian

II. Target Populations

A. Sumatran Rhinos

Recommend 150 individuals for each taxon;
ca. 20 founders for each taxon (ideally 10.10)
Two additional founders for Sumatran
Seventeen additional founders for Bornean
Twelve additional founders for Peninsular Malaysian

Animals should only be obtained from doomed populations; the existing captive Sumatran population should be used to develop effective husbandry protocols; ideally, the captive breeding programs should have some reproductive success before further captures are initiated. However, this does not preclude the acquisition of animals that become available opportunistically (e.g., rehabilitated or orphaned animals).

B. Javan Rhinos

Recommend adoption of Indonesian Rhino Conservation Strategy which states that the possibility of using captive breeding as a means of establishing additional populations is not under consideration. It is recommended that zoos be willing to offer assistance when requested for technological support of translocation.

III. Capacity Expansion Needs

If the above target population goals are to be achieved, there needs to be a substantial expansion of captive carrying capacity to accommodate additional animals (422 additional spaces needed worldwide; recommend 100 in Indonesia, 50 in Malaysia and 272 proportionally maintained in other regional programs; this would include at least 100 in North America). Careful attention should be given to the development of well-integrated regional programs in order to use space efficiently. There needs to be a concerted public

relations effort to encourage zoos to develop the necessary spaces. An alternative worth exploring is to develop large dedicated breeding facilities which can house several animals, particularly in the countries of origin.

IV. Interactions Between Regional Programs

Recommend that reporting protocol developed at Bogor Conference be implemented.

There should be a concerted effort to transfer relevant management technology (husbandry and veterinary care) between all regions.

Each region holding rhinos should identify a coordinator/management committee who is responsible for communication with the other regions and with other relevant organizations/agencies. (suggest Rhino Newsletter as a possible vehicle; suggest newsletter be translated into Indonesian/Malaysian)

Coordinator/management committee should prepare a masterplan for their respective regions. The plan should include both husbandry protocols and appropriate genetic and demographic analyses as needed.

Where they do not already exist, the Asian Rhino Specialist Group should stimulate the formation of such management committees.

As recommended by the AAZPA Rhino Advisory Group, we encourage those institutions that hold rhinos to ensure that all animals of breeding age in the captive population are in situations where males and females are together on a regular basis to increase the probability of reproduction.

V. Priorities For In Situ Protected Areas

Indonesia

(1) Ujung Kulon National Park (Javan)
(2) Kerinci-Seblat (Sumatran)
(3) Gunung Leuser (Sumatran)

Malaysia

(1) Taman Negara (Peninsular Malaysian)
(2) Endau Rompin (Peninsular Malaysian)
(3) Tabin Wildlife Reserve (Bornean)

Financial assistance: Recommend that zoological parks holding rhinos consider involvement in well-planned adopt-a-park programs in consultation with the Asian Rhino SSC and the relevant regional association. A component of such programs should include a community education aspect.

Technological assistance: especially in the following areas: biotelemetry, (for tracking), fecal analysis (nutritional, hormonal studies, parasites), infrasound (for possible use in censusing, identification), field necropsy protocols and training, standardized censusing techniques, foot prints (for possible identification), standardized techniques for recording field observations by guards, technological support for capture and translocations.

VI. Regional Priorities For In Situ Conservation

Recommend implementation of Asian Rhino SSC Action Plan and Indonesian Rhino Conservation Strategy (see attached).

VII. Statement Of Goals And Objectives

Goals and objectives for the three taxa are delineated in the Asian Rhino SSC Action Plan and the Indonesian Rhino Conservation Strategy and in notes from the 1992 AAZPA Rhino Advisory Group Mid-year Meeting (see attached).

VIII. Subspecies

Recommend that three subspecies are maintained until validation using molecular DNA and classical taxonomic studies are completed (see IUCN SSC Asian Rhino Action Plan). Holders should collect blood or tissue samples so that such studies can be undertaken.

INTERNATIONAL STUDBOOK

FOR

SUMATRAN RHINOCEROS
(*Dicerorhinus sumatrensis*)

30 SEPTEMBER 1992

Compiled by:

Dr. Thomas J. Foose & Dr. Zainal Zahari Zainuddin

SUMATRAN RHINO Studbook
(Dicerorhinus sumatrensis)

Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Birth-Origin	Country	Death-Date	Name	Breeder #
1	F	????	WILD	WILD	WMALAYSIA	30 Apr 1984	1	Wild Born			JERAM	MELAKA 1
					MALACCA	30 Apr 1984	1					
					SNG.DUSUN	13 Jan 1987	1		MALAYSIA			
					MALACCA	15 Aug 1987	1					
					SNG.DUSUN	31 May 1991	1		MALAYSIA			
2	M	~ 1984	WILD	WILD	WMALAYSIA	1 May 1984	UNK	Wild Born			ERONG	MELAKA 2
					MALACCA	1 Jun 1984	(died)			1 Jun 1984		
3	F	????	WILD	WILD	WMALAYSIA	18 Apr 1985	2	Wild Born			MELINTANG	MELAKA 3
					MALACCA	18 Apr 1985	2					
					BANGKOK	~ Jul 1986	UNK		THAILAND			
						~ Nov 1986	(died)			~ Nov 1986		
4	M	????	WILD	WILD	SUMATRA	25 Nov 1985	UNK	Wild Born	INDONESIA		TORGAMBA	LYMPNE 1
					LYMPNE	5 Apr 1986	UNK		ENGLAND			
5	F	????	WILD	WILD	SUMATRA	23 Jan 1986	UNK	Wild Born	INDONESIA		RIAU	
						23 Jan 1986	(died)			23 Jan 1986		
6	M	????	WILD	WILD	SUMATRA	2 Feb 1986	UNK	Wild Born	INDONESIA		ROKAN	SURBYA 1
					SURABAYA	~ May 1988	UNK		INDONESIA			
7	F	????	WILD	WILD	WMALAYSIA	10 Feb 1986	3	Wild Born			RIMA	MELAKA 4
					MALACCA	10 Feb 1986	3					
					SNG.DUSUN	13 Jan 1987	3		MALAYSIA			
					MALACCA	6 Mar 1987	3					
8	M	????	WILD	WILD	SUMATRA	23 Mar 1986	UNK	Wild Born	INDONESIA		JALU	JAKART 1
					JAKARTA	24 May 1986	UNK		INDONESIA			
9	M	????	WILD	WILD	SUMATRA	15 Jun 1986	6	Wild Born	INDONESIA		NAPANGGA	MELAKA 5
					MALACCA	25 Apr 1987	6					
						6 Aug 1987	(died)			6 Aug 1987		
10	F	????	WILD	WILD	SUMATRA	22 Jun 1986	UNK	Wild Born	INDONESIA		SUBUR	LYMPNE 2
					LYMPNE	25 Aug 1986	UNK		ENGLAND			
						30 Oct 1986	(died)			30 Oct 1986		
11	F	????	WILD	WILD	WMALAYSIA	6 Jul 1986	4	Wild Born			JULIA	MELAKA 6
					MALACCA	6 Jul 1986	4					
					SNG.DUSUN	13 Jan 1987	4		MALAYSIA			
					MALACCA	21 Apr 1989	4					
						15 Dec 1989	(died)			15 Dec 1989		
12	F	????	WILD	WILD	WMALAYSIA	9 Sep 1986	5	Wild Born			DUSUN	MELAKA 7
					MALACCA	9 Sep 1986	5					
					SNG.DUSUN	13 Jan 1987	5		MALAYSIA			
					MALACCA	6 Mar 1987	5					
					JAKARTA	25 Apr 1987	UNK		INDONESIA			

Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Birth-Origin	Country	Death-Date	Name	Breeder #
13	F	~ 1983	WILD	WILD	WMALAYSIA	25 Feb 1987	7	Wild Born			PANJANG	MELAKA 8
					SNG.DUSUN	25 Feb 1987	7		MALAYSIA			
					MALACCA	5 Mar 1987	7					
					SNG.DUSUN	25 Sep 1987	7		MALAYSIA			
					MALACCA	20 Apr 1989	7					
					SNG.DUSUN	27 Apr 1991	7		MALAYSIA			
14	M	????	WILD	WILD	SABAH	26 Mar 1987	UNK	Wild Born	MALAYSIA			
						26 Mar 1987 (died)				26 Mar 1987		
15	F	23 May 1987	WILD	7	MALACCA	23 May 1987	8	Captive Born			MINAH	MELAKA 9
16	F	????	WILD	WILD	WMALAYSIA	1 Jul 1987	9	Wild Born			SERIDELIMA	MELAKA10
					MALACCA	1 Jul 1987	9					
						23 Sep 1988 (died)				23 Sep 1988		
17	M	????	WILD	WILD	SABAH	14 Jul 1987	UNK	Wild Born	MALAYSIA		TENEGANG	SEPILOK1
					SEPILOK	14 Jul 1987	UNK		MALAYSIA			
						22 Apr 1992 (died)				22 Apr 1992		
18	F	????	WILD	WILD	SUMATRA	21 Jul 1987	UNK	Wild Born	INDONESIA		MERANTI	LYMPNE 3
					LYMPNE	30 Apr 1988	UNK		ENGLAND			
19	F	????	WILD	WILD	WMALAYSIA	26 Aug 1987	10	Wild Born			MAS MERAH	MELAKA11
					MALACCA	26 Aug 1987	10					
					SNG.DUSUN	2 May 1991	10		MALAYSIA			
20	M	~1984 +/-1yr	WILD	WILD	WMALAYSIA	26 Mar 1988	11	Wild Born			SHAH	MELAKA12
					MALACCA	26 Mar 1988	11					
					SNG.DUSUN	2 May 1991	11		MALAYSIA			
21	M	????	WILD	WILD	SABAH	24 May 1988	UNK	Wild Born	MALAYSIA			
						25 May 1988 (died)				25 May 1988		
22	F	????	WILD	WILD	SUMATRA	8 Jul 1988	UNK	Wild Born	INDONESIA		DALU	BOGOR 1
					TAMNSAFAR	30 Nov 1988	UNK		INDONESIA			
23	F	????	WILD	WILD	WMALAYSIA	11 Jul 1988	12	Wild Born			SEPUTIH	MELAKA13
					MALACCA	12 Jul 1988	12					
					SNG.DUSUN	31 May 1991	12		MALAYSIA			
24	F	????	WILD	WILD	SUMATRA	22 Jul 1988	UNK	Wild Born	INDONESIA		MAHATO	CINC 1
					LOSANGELE	25 Nov 1988	UNK		U.S.A.			
					CINCINNAT	5 Jun 1989	UNK		U.S.A.			
						10 May 1992 (died)				10 May 1992		
25	F	????	WILD	WILD	SUMATRA	24 Jul 1988	UNK	Wild Born	INDONESIA		KUMU	SANDGO 1
					SANDIEGOZ	25 Nov 1988	UNK		U.S.A.			
26	F	????	WILD	WILD	SABAH	22 Apr 1989	UNK	Wild Born	MALAYSIA		LUN PARAI	SEPILOK2
					SEPILOK	22 Apr 1989	UNK		MALAYSIA			

Stud #	Sex	Birth Date	Sire	Dam	Location	Date	Local ID	Birth-Origin	Country	Death-Date	Name	Breeder #
27	F	26 Aug 1989	WILD	WILD	SUMATRA	26 Aug 1989	UNK	Wild Born	INDONESIA		RAPUNZEL	BRONX 1
					LOSANGELE	29 Nov 1989	UNK		U.S.A.			
					NY BRONX	16 May 1990	UNK		U.S.A.			
28	M	????	WILD	WILD	SUMATRA	23 Jul 1990	UNK	Wild Born	INDONESIA		BAGUS	CINC 2
					SANDIEGOZ	10 Apr 1991	UNK		U.S.A.			
					CINCINNAT	25 Oct 1991	UNK		U.S.A.			
29	F	????	WILD	WILD	SUMATRA	6 Mar 1991	UNK	Wild Born	INDONESIA		IPAK	LA 1
					LOSANGELE	23 Nov 1991	UNK		U.S.A.			
30	M	????	WILD	WILD	SUMATRA	18 Apr 1991	UNK	Wild Born	INDONESIA		ROMI	BOGOR 2
					TAMNSAFAR	2 Sep 1991	UNK		INDONESIA			
31	M	????	WILD	WILD	SABAH	5 May 1991	UNK	Wild Born	MALAYSIA		TAKALA	SEPILOK3
					SEPILOK	5 May 1991	UNK		MALAYSIA			
32	F	????	WILD	WILD	SUMATRA	17 May 1991	UNK	Wild Born	INDONESIA		BINA	BOGOR 3
					TAMNSAFAR	2 Sep 1991	UNK		INDONESIA			
33	F	????	WILD	WILD	SUMATRA	12 Jun 1991	UNK	Wild Born	INDONESIA		RAMI	SRT 1
					SANDIEGOZ	23 Nov 1991	UNK		U.S.A.			
						25 May 1992 (died)				25 May 1992		
34	F	17 Jan 1992	WILD	WILD	SUMATRA	17 Jan 1992	UNK	Wild Born	INDONESIA		WIWIEN	SURBYA 2
					SURABAYA	25 Jul 1992	UNK		INDONESIA			
35	M	20 Mar 1992	WILD	WILD	SUMATRA	20 Mar 1992	UNK	Wild Born	INDONESIA			SANDGO2
					SANDIEGOZ	29 Aug 1992	UNK		U.S.A.			
36	M	28 Aug 1992	WILD	WILD	SABAH	28 Aug 1992	UNK	Wild Born	MALAYSIA		SIDOM	SEPILOK4
					SEPILOK	28 Aug 1992	UNK		MALAYSIA			

TOTALS: 14.22.0 (36)

SUMMARY - CAPTIVE PROGRAMS
SUMATRAN RHINO - 1984 TO 1992

COUNTRY	CAPTURED	BORN	IMPORTED	EXPORTED	DIED	ALIVE
P. MALAYSIA	2/9	0/1	1/0	0/2	2/2	1/6
SABAH	5/1	0/0	0/0	0/0	3/0	2/1
INDONESIA	7/11	0/0	0/1	4/7	0/1	3/4
THAILAND	0/0	0/0	0/1	0/0	0/1	0/0
U.K.	0/0	0/0	1/2	0/0	0/1	1/1
U.S.A.	0/0	0/0	2/5	0/0	0/2	2/3
TOTAL	**14/21**	**0/1**	**4/9**	**4/9**	**5/7**	**9/15**

T.J. Foose
30 September 1992

SUMATRAN RHINOCEROS
LIVING IN CAPTIVITY
(30 September 1992)

COUNTRY	INSTITUTION	MALES	FEMALES	TOTAL
Indonesia	Jakarta	1	1	2
	Surabaya	1	1	1
	Taman Safari	1	2	3
	Ipuh	0	0	0
	Subtotal Indonesia	***3***	***4***	***7***
Malaysia				
Peninsula	Malacca	0	2	2
	Sungai Dusun	1	4	5
	Subtotal P. Malaysia	***1***	***6***	***7***
Sabah	Sepilok	2	1	3 *
	Subtotal Sabah	***2***	***1***	***3*** *
United Kingdom	Port Lympne	1	1	2
	Subtotal U.K.	***1***	***1***	***2***
United States	Cincinnati	1	0	1
	Los Angeles	0	1	1
	New York	0	1	1
	San Diego	1	1	2
	Subtotal U.S.A.	***2***	***3***	***5***
WORLD TOTAL		**9**	**15**	**24**

SUMATRAN RHINO MORTALITY BY YEAR
1984 - 1992

	1984	1985	1986	1987	1988	1989	1990	1991	1992
Captures	2	2	8	6	6	2	1	5	3
Births	0	0	1	0	0	0	0	0	0
Deaths	1	0	3	2	2	1	0	0	3
Population at Risk	2	3	11	15	19	19	19	24	27
% Mortality	50	0	27	13	11	5	0	0	11

T.J. Foose
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SUMATRAN RHINO
MORTALITY SUMMARY
BY COUNTRY OF ORIGIN
1984-1992

	CAPTURED	DIED	% MORTALITY	LAST DEATH
Indonesia	18	5	29	1992
P. Malaysia	11	4	36	1989
Sabah	6	3	50	1992
Total	**35**	**12**	**34**	

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SUMMARY OF MORTALITY
SUMATRAN RHINO IN CAPTIVITY
1984-1992

Animal	Sex	Date & Place of Capture	Date & Place of Death	Date to Death Place	Cause of Death	Condition & Age at Capture
2 Erong	M	01-05-84 Malaysia	01-06-84 Malacca	01-05-84	Inanition	Poor/Calf (est. 3 mo.) Discovered abandoned in jungle
3 Melintang	F	18-04-85 Malaysia	15-11-86 Bangkok	00-07-86	Accident: Ensnared Neck in Enclosure	Good/Adult
5 Riau	F	23-01-86 Sumatra	23-01-86 Sumatra	23-01-86	Accident: Died of Trauma in Corral Trap	Good/Adult
9 Napangga	M	15-06-86 Sumatra	06-08-87 Malacca	25-04-87	Acute Colic	Poor/Adult
10 Subur	F	25-06-86 Sumatra	30-10-86 England	25-08-86	Digestive	Marginal/Adult
11 Julia	F	06-07-86 Malaysia	15-12-89 Malacca	06-07-86	Cecal Impaction	Good/Adult
14	M	26-03-87 Sabah	26-03-87 Sabah	26-03-87	Capture Trauma	?/Adult
16 Seridelima	F	01-07-87 Malaysia	23-09-88 Malacca	01-07-87	Salmonella	Marginal/Adult
17 Tenegang	M	14-07-87 Sabah	22-04-92 Sepilok	14-07-87	Hindgut Obstruction	?/Adult
21	M	24-05-88 Sabah	25-05-88 Sabah	24-05-88	Capture Trauma	?/Adult
24 Mahato	F	22-07-88 Sumatra	10-05-92 Cicinnati	05-06-89	Unknown	Good/Adult
33 Rami	F	12-06-91 Sumatra	25-05-92 San Diego	23-11-91	Gut Torsion	Good/Adult

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RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 6

RESEARCH

RESEARCH WORKING GROUP

Working Group: *B. Dresser, N. Czekala*

1.1 Veterinary research

Different species will require different types of veterinary input. In general for all species the following holds true:

Development of protocols and recording systems for the veterinary management and collection of data are needed. Medical training and the development of suitable handling areas for routine sampling and to facilitate emergency care should be encouraged. Three main categories of sampling would be:

a) Non-invasive collection of normal baseline physiological data from healthy animals (Including paediatric parameters).

b) Opportunistic sampling of animals under clinical care (including routine procedures e.g. sedation, translocation etc.). This may include various clinico-pathological samples; drug serum levels (e.g. antibiotics, antiparasiticides, anesthetics etc.); toxicological studies; virological studies; etc.

c) Autopsies should be routine and pathological samples collected from dead/euthanized. At this time the following tissue samples (2-4 cm in size) should be collected and stored in formalin: liver, kidney, spleen and whole reproductive tracts (male and female) and eyes. If an animal is euthanized, fresh tissue samples should be taken and the reproductive tract should be removed; eggs or sperm prepared for freezing and banked in liquid nitrogen. Pathologists with special interest/expertise in rhinos should be identified as a source of expertise.

Constraints in successfully managing black rhino in captivity include serious disease problems. Of particular note is haemolytic anaemia (HA) and oral/skin ulcers which has resulted in numerous mortalities in captive rhinos. Black rhinos have an inherent problem with their red blood cell enzymes resulting in a high susceptibility to oxidant stressors. Continued research related to this problem is vital including further RBC studies, infectious diseases especially the role of leptospires, nutritional aspects especially vitamin E levels and the role of low phosphorous levels in the aetiology of HA.

There are serological banks for rhinos that are being coordinated by Dr Eric Miller (St. Louis Zoo) in conjunction with Dr Evan Bloomer - for captive samples (Fossil Rim, Texas) and Dr Dave Jessup - for free-living samples (International Wildlife Veterinary Services, California). Institutions involved with veterinary research in black rhino are encouraged to coordinate through Dr Miller. All captive institutions involved with black rhino are also encouraged to contribute financially to support of veterinary research on this species.

1.2 Behavioral research

A minimum of 1 personnel (keeper) should spend a minimum of 1 hour per day observing and recording the behavior of captive animals. The following behaviors should be recorded on a continuous basis: vocalization, urine spraying, chasing, aggression (pushing, shoving, slashing with lower canine) and mounting. The data should be collected at the same time daily (e.g. 8.00 - 9.00 am). Each time a behavior occurs, the time (to the closest minute) and identity of the animal exhibiting the behavior should be recorded. The date and amount of time the animals were observed should also be recorded. It would also be useful to record the ambient temperature and weather conditions (sunny, raining etc). Descriptive notes should be taken on any new or unusual behaviors. Each data sheet should also note whether a pair was together or apart.

1.3 Nutritional research

(1) Due to digestive tract morphology, the domestic horse probably represents the best nutritional model for all rhinoceros species. Proper documentation of quantities and nutrient composition of diets for to captive rhino populations should be a priority.

(2) Institutions holding rhinos are encouraged to collaborate with Dr. Ellen Dierenfeld at the New York Zoological Society on the further analysis and development of diets.

(3) Whenever possible, blood and tissue (liver, heart, adipose, skeletal muscle) samples should be collected and properly retained for analysis of vitamin E and mineral concentrations.

1.4 Reproductive research

(1) It is vital to develop technology to permit evaluation of the oestrus cycle and pregnancy in the rhino. Urine faecal, saliva and blood samples should be collected in collaboration with specific studies for determination of hormone metabolites. Technology should be developed to permit pregnancy diagnosis of free-ranging populations. This has been successfully developed for black rhino but needs to be adapted for other species.

(2) Pheromone and scent marking studies should be performed in captivity and in the wild.

(3) Collection, evaluation and storage of semen should be carried out collaboratively between zoos and universities.

(4) Institutes holding rhinos should collaborate with Dr Nancy Czekala (San Diego Zoo) and Dr Helen Shaw (Institute of Zoology, Zoological Society of London) in their studies of hormone metabolites in urine, faecal and saliva samples.

(5) Of interest is the use of faecal samples to determine the sex of rhinos in the wild. The ability to differentiate between males and females in captivity through faecal analysis could be extremely helpful to those working with rhinos in the field.

(6) Reproductive technologies such as embryo transfer, artificial insemination and in vitro fertilization are tools that need to be developed for the rhino. Institutions interested in collaborating in the development of techniques for the rhino should contact Dr Betsy Dresser (Cincinnati Zoo). Females being considered for euthanasia can be hormonally treated and attempts made to recover oocytes of embryos at necropsy.

Current status - Assisted Reproductive Technology

(1) Artificial Insemination/Semen Collection and Preparation

Semen has been collected from white,black and sumatran rhinos through electro-ejaculation, rectal massage and at necropsy(from the epididymides). General quality of semen has been poor to begin with - approximate motility at 50%. Cryopreservation of rhino semen has usually resulted in a 20% loss of motility, with a resulting viability of only 30%.

Another problem or unknown involved with artificial insemination may also be due to the volume of semen available for insemination and the mechanism by which semen is packaged. Freezing semen by methods adequate for bovids may not be suitable for rhinos. Therefore once semen is thawed and available for insemination, the volume necessary to produce a pregnancy may still remain a question.

Only in Indian Rhinos is the time of ovulation somewhat predicable. For other species at the present time, attempts at artificial insemination are premature. Instrumentation for A.I. also needs to be developed.

Anaesthesia for development of reproductive technology such as A.I. needs to be further explored. Chutes for restraint are becoming further utilized and more facilities are incorporating them into their management plans.

Some banks for rhino semen exist but they are few in number and are reporting low sperm viability.

(2) Embryo Collection and Transfer

Viable embryos have not yet been collected for any subspecies of rhino, therefore no transfers have been attempted.

(3) In vitro fertilization

Only a few oocytes have been recovered at necropsy from white and black rhinos. Attempts have been made to put the oocytes with frozen-thawed semen but no such attempts have resulted in confirmed fertilizations.

Reproductive Endocrinology

In order to promote timed matings, assisted reproduction, determine and treat infertility, assess ovarian suppression, techniques must be established and validated to measure ovarian hormones and hormonal metabolites.

Indian Rhino Ovarian and pregnancy status can be determined by urinary hormone analysis.

Black Rhino Ovarian and pregnancy status can be determined by urinary hormone analysis - Hodges (Gottigen, Germany). Ovarian and pregnancy status can be determined by salivary hormone analysis (Czekala, S.D.) Pregnancy diagnosis by faecal hormone analysis (Bambeng, Vienna).

Reproductive success is poor. The cause, whether ovarian suppression, male infertility etc. needs to be examined if target populations ore to by realized.

Sumatran Rhino No techniques have been validated for ovarian or pregnancy hormone monitoring. A major hindrance is the lack of known normal cycling or pregnant females to permit assay validation. Urinary hormones are being tested by Helen Shaw (Z.S.L.) and Nancy Czekala (S.D.). Faecal hormone analysis is being attempted (Czekala, S.D.).

White Rhino Urinary hormones are currently evaluated by Bamberg (Vienna), Hodges (Gottigen) and Shaw (London)

1.5 Genetic research

(1) Ongoing and proposed research on taxonomic issues should continue. Resolution of the subspecies question is a high priority and has important implications for the development of a global plan management for rhinos.

(2) In a case of an autopsy the following tissue samples (2-4 cm in size) should be collected and frozen for genetic analysis: liver, kidney, spleen.

(3) Hair samples should also be collected, sealed in plastic bags and stored at room temperature (i.e., if a freezer is not available)

The procedures and arrangements should be worked out. the veterinarian in charge should be thoroughly familiar with the procedures for bleeding and preparing the blood for analysis.

Samples for research on taxonomic status are currently being analyzed at the New York Zoological Society. Any samples are of great value (blood samples, Skin biopsies, Necropsy sample etc.) Please contact George Amato, Conservation Geneticist (N.Y.Z.S). In addition, for maximizing genetic variability accurate stud books are necessary. It should be noted if a female is put together with a number of males and if necessary, paternity testing can be done.

Northern Whites

Cytogenetics have been studied at San Diego on a total of 32 *C.simum* individuals from 9 different institutions, including 8 males and 19 females of the southern subspecies (*C.s.simum*), 2 females and 3 females of the northern subspecies (*C.s.cottoni*) as well as one subspecies hybrid. A summary of the diploid chromosome number of these animals were found to be 2n=82 with the exception of one 2n=81 *C.s.cottoni* male which appears to be the result of a simple Robertsonian translocation between two of the smaller acrocentric chromosomes. (Houch and Ryder, in prep.)

The finding of an apparently aberrant karyotype in the breeding bull (No. 372, Sudan) raises the possibility that this individual, through the production of duplication/deficient gametes as a result of the nondisjunction of homologous elements in the meiosis, could contribute to the production of aneuploid zygotes resulting in foetal wastage. The chromosomal status of No. 372 Sudan's surviving offspring (Nabire and Najin) as well as investigation of any aborted foetuses could shed light on the question. These studies would seem to be an urgent priority.

1.6 Genetic resource banking

There is ample justification for collecting and preserving and variety of samples for research, population management and reproductive enhancement in support of conservation efforts. These materials include blood samples, skin biopsies, gametes and embryos. These samples provide potential source for DNA, cell strains and viable organisms.

Research activities focusing of collection, preparation and long-term storage of these biological resources need to be delineated, efforts coordinated and funding secured to realize the potential conservation benefit.

1.7 Other

(1) Field workers have identified a need to record foot print patterns of animals and how they change with age. Such information could be used to aid census efforts in the wild.

(2) Captive animals could also be used to work out additional technological and practical problems facing field researchers. For example, there is a need to develop a method to radio telemetry equipment to rhinos. Captive rhinos should be used to help develop this technology.

RHINO

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SECTION 7

SYSTEMATICS

SYSTEMATICS WORKING GROUP

Working Group: *G. Amato and O. Ryder*

The CBSG created an Ad Hoc Advisory Group to comment on the current state of data in reference to the following questions:

1. Does the genetic data currently presented support attempts to conserve *D. b. michaeli* and *D. b. minor* as separate populations?

2. What further specific studies would test the hypotheses that these populations have or have not diverged sufficiently to justify conservation as separate populations?

Responses were communicated to this meeting by G. Amato, J. Cracraft, G. McCracken, E. Maruska, R. Lande, R. Lacy, R. Wayne, O. Ryder, K. Willis, and R. Wiese.

One important, yet not totally unexpected, result was that the discussion indicated that there is not yet a consensus on what a subspecies is, what role subspecies research should play in determining conservation strategy, and whether there are different goals for ex situ and in situ programs. We believe it is accurate to say that more questions were raised then answered. As stated earlier, this result was not unexpected to those of us who have conducted basic research in evolutionary biology and population genetics given the fact that within these fields there is not even a consensus as to what a species is.

While these discussions may be frustrating to managers and others in the conservation field, it is important to recognize the value of the primary data in developing our strategies. Additionally, it argues for the necessity of tackling these basic questions of what a subspecies is and what are our goals in terms of preserving evolutionary novelty (especially in captive populations). Articulating goals and methods to resolve these important questions has been a useful outcome of CBSG activities. Consideration of basic theoretical issues as well as definition of goals allows the logical development of more useful applied approaches for conservation.

In this context we would like to address some general and specific points of "near" consensus:

First, it is important to emphasize the value of comparative data sets in the resolution of these questions. The more information we have on morphological, behavioral, ecological, and genetic data, the better. Concordance (or the lack of concordance) would indicate which questions are in most need of further research. We do recognize that recent developments in molecular genetics allow us to survey for many more characters then in the past, and at a far greater level of resolution. Since morphology, behavior, etc. is coded in the genome, it is likely that if differences exist between populations, that differences in rapidly evolving areas of the genome will easily be detected. However, other aspects of genome structure and organization

will only be revealed by cytogenetics studies. While chromosomal studies have been utilized in systematic and evolutionary biology studies for decades, the necessity of undertaking chromosomal investigations for assessing genetic divergence of species and subspecies remains, in spite of the spectacular advances in molecular genetics analytical capabilities.

Karyotypic distinction of populations is strong evidence for restricted gene flow, reproductive isolation and speciation. However, karyotypic similarity of identity of populations does not indicate that no significant divergence has occurred. In these instances, molecular genetics studies are indicated. Whenever possible we should analyze the same data sets for both chromosomal information and DNA sequence data.

Beyond collecting these data sets we need to tackle the following issues:

1. What is a subspecies/E.S.U./conservation unit (i.e. any population diagnosably distinct, or if minimally diagnosable should we characterize the levels of genetic differentiation?)?

2. Should our strategy for determining conservation units in captive propagation programs reflect exactly, largely, or not at all our strategy for in situ programs. There is much disagreement about this; and it is unclear what role practical considerations (e.g. space limitations, financial limitations) should play in these discussions. Additionally, arguments about what sorts of captive populations are most wanted--or likely to be successful for reintroductions will need to be considered. These issues will need to be discussed with managers as well as among conservation geneticists.

Where does all of this leave us with respect to the original questions about black rhinos, as well as other rhino subspecies questions?

The closest we come to a consensus is as follows:

1. In situ programs should be most concerned with preserving existing local populations. In spite of the dramatic decline of rhinos in the wild, there are still sufficient numbers of individuals of recognized "subspecies" to avoid the possible problems from mixing populations that may have subtle adaptive differences. In the future we may have a problem with too few Northern white rhinos, or problems with this population having passed through too small a "bottleneck".

2. Chromosomal studies of white rhinos require expansion. While a large number of C. s. simum have been karyotyped, relatively few C. s. cottoni have been investigated. Importantly, one individual in the captive population appears to have a different diploid number, possibly the result of a chromosome fusion. This animal has sired offspring and fathered an aborted fetus. Confirmation of the karyotypic status of this male with a chromosomal rearrangement through newly collected samples is an urgent priority. Investigation of chromosomal and DNA sequence data of the remaining ex situ and in situ populations remains a high

priority. This is especially urgent if population reinforcement from the captive population is to be considered.

3. Eastern and Southern black rhinos appear to fall into the category of "minimally distinct". The results of molecular genetics analyses of black rhinos suggest that diagnostic differences may exist between eastern and southern forms, although the number of animals sampled to produce these findings is small. Additional data (including considerable DNA sequence data) exist but are not yet published. Low levels of genetic variation in isoenzyme loci and in mitochondrial DNA (mtDNA) have been observed in Diceros bicornis. While the available data are consistent with the hypothesis that the eastern and southern populations represent distinct historical lineages, the extent of divergence of these lineages is relatively small. The molecular data has been sited to both support the notion of clinal variation as well as the possibility of historical lineages. Due to the fragmentation of the populations, it may be impossible to resolve which of these hypotheses is accurate.

The results of chromosomal studies suggest that a genetic discontinuity may exist between the eastern rhinos in Kenya and the southern rhinos in Zimbabwe. Additional heterochromatic arms are observed in a small sample of black rhinos from Kenya. Whether these differences would result in decreased fertility has not been tested, nor would it be likely to be tested experimentally. Additional karyotype data is a high priority.

The significance of the observed genetic differences between the eastern and southern populations in terms of physiology, reproductive potential, ecological adaptations and disease is not known.

There is no reason to change our in situ strategy at present, but whether we could justify mixing our captive populations needs to be addressed when the context of our captive propagation goals. At this time, the weight of opinion argues for maintaining the Eastern and Southern populations as separate management units in our ex situ program.

4. Preliminary DNA sequence data on Sumatran rhinos indicates that three populations (peninsular Malaysia, Sumatra, and Borneo) are diagnosably distinct. Chromosomal studies on a few individuals have not revealed differences in chromosome number. It is recommended that in situ and ex situ programs should treat these as separate units at this time. Further data on the level of differentiation will be considered, once again, after we resolve our general goals.

5. At this time, there is not an indication of a subspecific question for the Indian/Nepali rhino.

6. If a viable population of Javan rhinos is found in Viet Nam, then the subspecies issue will need to be investigated for this taxon.

In summary, we have made specific recommendations on subspecies of rhinos while recognizing that it is more important then ever to reexamine the "dilemma of subspecies" for

conservation. Zoo geneticists, acting as conduits between academic researchers (in evolutionary biology, systematics, and population genetics) and conservation managers should address these general issues. This group, as a subcommittee of CBSG would have the best chance of articulating a useful statement of goals, methods, and analyses to make further progress in the application of rigorous science to these important conservation questions.

We recognize that other factors in addition to genetic differences among subspecies are involved when making decisions concerning conservation of populations within the larger context of species conservation.

Conservation efforts for in situ populations should be structured to retain the full range of local genetic variation. Whenever feasible, ex situ programs should reflect the zoogeographical and phylogenetic structure of wild populations. Although divergence of ex situ populations will inevitably occur, captive management techniques can minimize the extent and rate of divergence of captive and wild populations. Furthermore, regular genetic inputs from wild populations, if possible, can further reduce divergence of ex situ populations relative to their wild source populations.

Carefully managed captive populations that reflect natural zoogeographical and phylogenetic population substructure, whether corresponding to subspecies designations or not, are a valid source for reintroduction and ex situ - in situ metapopulation management.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 8

IN SITU SUPPORT

IN SITU WORKING GROUP

Working Group: *(Chair) R. Tilson, M. Khan, N. Van Strien, J. Manansang, M. Hutchins, P. Wells, M. Kock, M. Brooks, V. Wilson*

The recommendations of the *In Situ* support (Adopt a Park Program) are outlined below. Africa and Asia are considered as distinct areas. The areas considered suitable are: distinct areas were funding is required, the funding will not necessarily be large but will provide a significant benefit to the park as a supplement to existing or proposed funding from other sources, and the areas are distinct so allowing tangible 'adoption'.

ASIAN RHINOS AND PROTECTED AREAS

Indian Rhino

There are two parks in Nepal; Chitwan and Bardia. There are 6 parks in India; Kairanga, Manas, Orang, Pobitora, Jaldapara and Dudwa.

There are 42 World Zoos holding Indian Rhinos. 25 in 'Hard Currency' Countries; 14 in Europe, and 11 in North America.

Programmes for these protected areas are suggested in the report from the Global Rhino Workshop Report 'Indian Rhino Section'.

Javan Rhino

There are no Javan Rhinos in captivity.

There are two protected areas for Javan Rhinos, the Southern Form in UK on Java, and the Northern Form in Nam Cat Tien in Vietnam. There is already a programme in place in UK, supported by The Minnesota Zoo, New Zealand Nature Conservation, and WWF.

The Northern form in Vietnam should have a programme for assessing the status, distribution, and development of a management strategy.

Sumatran Rhino

There are currently 28 Sumatran rhinos in captivity. There are 6 in North America and 2 in Europe and 18 in Asia.

There are four 'Forms' recognized. The 'Burma Form' is too poorly known to produce any recommendations. The Sumatran form has two parks that are considered of high priority, Gunung Leuser and Kerici Seblat. Programmes that include; park infrastructure support, Community Education, Survey, and anti-poaching support are recommended.

The P. Malaysian form has two parks of priority Endau Rompin and Taman Negara but only the former is in need of support. In Endau Rompin Infrastructure Support and Community Education is most needed.

There is the Borneo form and there is one park Tabin Wildlife Reserve that is considered of high priority. The requirements are as for Endau Rompin.

FUNDING

The recommended cost of 'Adopt A Park Programme' for the ten parks above is $250,000. This will not pay for all the expenses of these parks but will provide a significant support. We recommend the approximate 25 'Hard Currency' Zoos contribute $10,000 per year for a minimum of three years to initiate the programmes.

We also recommend the Zoos support the annual cost fore the IUCN/SSC Asian Rhino Specialist Group, as set out below:

	$
Chairman Travel (2 trips)	2,000
Group Travel (10 people, 1 trip)	10,000
Correspondence	500
Annual News Letter	1,200
	14,000

We recommend these costs be proportioned accordingly; $7,000 from 11 N. American Zoos, $3,500 from Australian Zoos, and $3,500 from 15 European Zoos.

AFRICAN RHINOS AND PARKS

Black Rhino

Some recommendations for the 'Adopt a Park Programme' were made by the African Rhino Specialist Group as outlined below by country. This is not an exhaustive list.

Cameroon

There are a number of areas in the Cameroon that are protected areas which contain 30 to 50 Western Black rhinos.

The requirements are; surveys to assess status and distribution of rhinos, development and implementation of a management plan.

Tanzania

The Selous N.P. that contains an unknown breeding population of Southern Black rhinos.

Infrastructure support for key sanctuary areas within the Selous N.P. is required.

Zimbabwe

Four areas are considered of importance; Manapool Mutuzadonna, Chizaria, and Hwange. They contain Southern Black and Southern White rhinos.

The requirement are infrastructure support, management strategy development, conservancy support, and community education for example Camp Fire Programmes.

Mozambique

The important areas are not defined but there is a need for a relocation project of relic populations of Southern Black to sanctuaries elsewhere in Southern Africa. This needs to be confirmed from Government Authorities.

Botswana

The areas are not defined containing Southern Black but there is a need to create the Khama Rhino Sanctuary, for Chobe rhino.

Namibia

The important area is Damaraland containing South West Black. There is a need for a population monitoring programme.

Zaire

The area of importance is Garamba for the Northern White. There is a need for a population monitoring programme.

FUNDING

The recommended cost of 'The Adopt A Park Programme' for the ten programmes is $250,000. We recommend the approximate 100 suitable Hard Currency Zoos with African Rhinos contribute $2,500 per year for a minimum of three years to initiate the programmes.

We also recommend the Zoos support the annual cost for the IUCN/SSC African Rhino Group, as set out below:

	$
Chairman Travel (2 Trips)	2,000
Group Travel (10 people, 1 trip)	10,000
Preparation of Action Plan & Management Guidelines	10,000
Establish African Rhino Data Base	5,000
	27,000

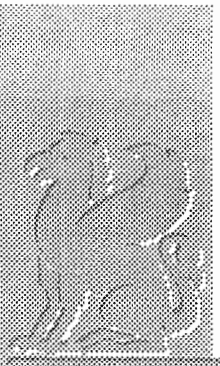
We recommend these costs be proportioned accordingly; $11,000 from N. American Zoos, $11,000 from European Zoos, and $5,000 from Australian Zoos.

Slide: 1870#01 Opid: MN Zoo Job #: 11870 DDS:6000 size: 5292 Mon May 4 13:47:52 1992

ADOPT-A-PARK GUIDELINES FOR SUCCESSFUL PARTNERSHIP

- Establish a Commonality of Interest Between Zoo's Interest and Park Needs to Sustain the Effort
- Commit to a Long-Term Relationship on Both Sides
- Emphasize a "Grass-Roots" Approach to Place Financial Support Directly into Park Programs
- Select Programs of Modest Costs and Visible Benefits to Sustain Continued Investment
- Develop Marketing and Communication Programs on Both Sides to Sustain Good Will (G. Rabb, IUCN/SSC)

Slide: 1870#04 Opid: MN Zoo Job #: 11870 DDS:6000 size: 5354 Mon May 4 21:08:51 1992



ADOPT-A-PARK BENEFITS TO INSTITUTION

- Creates a Direct Relationship Between *Ex Situ* and *In Situ* Conservation Activities
- Demonstrates Zoo's Resolve to Conserve Biodiversity on an Ecosystem Level, Not Just Species Level
- Provides Focus and Fund Raising Opportunities for Zoo's Conservation Exhibit
- Collectively, Zoos Evolve from Being "Zoological Parks" to "Conservation Centers" (G. Rabb, IUCN/SSC)

Slide: 1870#05 Opid: MN Zoo Job #: 11870 DDS:6000 size: 5338 Mon May 4 21:16:35 1992

ADOPT-A-PARK
STARTING YOUR OWN PROGRAM

- Draft a Zoo Conservation Policy That Pledges "To Support the Preservation and Restoration of Endangered Species' Natural Habitats" (Minnesota Zoo 1990)
- Identify an "Umbrella Species" That Symbolizes This Commitment
- Locate a Priority Protected Area That Meets This Requirement
- Commit Financially to 3 Years of Infrastructure Support (US $25,000 per Year or Less) and a Long-Term Presence as Funds Permit
- Formalize "Points of Agreement" Between Zoo and Host Country Wildlife Authority

Slide: 1870#03 Opid: MN ZOO Job #: 11870 DDS:6000 size: 5134 Wed Sep 30 16:58:02 1992

ADOPT-A-PARK
A RHINO OVERVIEW

- There are 5 Rhino Species; 2 African and 3 Asian
- They Live in 37 Major Protected Areas; 18 African and 19 Asian
- Costs to Adopt (US $25,000) Total US $925,000
- There are 290 Zoos Worldwide with Rhinos; 266 with African and 52 with Asian
- Costs per the 200 'Hard Currency' Zoos to Adopt Major Protected Rhino Populations is US $4,625/Yr.

Slide: 1870#06 Opid: MN Zoo Job #: 11870 DDS:6000 size: 2060 Mon May 4 21:26:51 1992

Priority Sanctuaries for Rhino

Africa	Sanctuary
Kenya	Aberdare, Masai Masa, Nairobi, Nakuru, Tsavo, Solio, Laikipia
Tanzania	Selous
Zaire	Garamba
Zimbabwe	Hwange/Matetsi, Sebungwe, Zambezi, Central Highlands
Nambia	Etosha, Kaokoland
South Africa	Hluhluwe/Umfolozi, Kruger, Mkuzi

Minnesota Zoo

Slide: 1870#07 Opid: MN Zoo Job #: 11870 DDS:6000 size: 2302 Mon May 4 21:30:25 1992

Priority Sanctuaries for Rhino

Asia	Sanctuary
Indonesia	
Sumatra	Kerinci Seblat, Gunung Leuser, Barisan Selatan, Way Kambas
Java	Ujung Kulon
Kalimantan	Kayan Mentarang
Malaysia	
Peninsular	Taman Negara, Endau Rompin
Sabah	Tabin, Danum Valley
Sarawak	Ulu Limbang
Vietnam	Nam Cat Tien, Bugiamap
India	Dudhwa, Kaziranga, Manas, Orang
Nepal	Chitawan, Bardia

Minnesota Zoo

Slide: 1870#02 Opid: MN Zoo Job #: 11870 DDS:6000 size: 5014 Mon May 4 13:57:24 1992

ADOPT-A-PARK
KERINCI SEBLAT NATIONAL PARK
CENTRAL SUMATRA, INDONESIA

- 14,000 Sq. Km of Evergreen and Montane Forest Next to Mt. Kerinci
- Largest Conservation Area in Sumatra, Protects Watershed of 10 Million Ha.
- Contains Largest Population of Sumatran Rhino (500), Stronghold of Sumatran Tiger, 6 Species of Primates and 130 Species of Birds

The Javan Rhino as a Flagship Species

Not surprisingly, the Javan rhino has been chosen as the official symbol for Ujung Kulon National Park. But efforts mounted to protect the Javan rhino and its habitat will do much more than safeguard a living symbol of this wilderness, they will help preserve one of the most diverse ecosystems in the world.

Java is an island of Indonesia, an archipelago nation in the Asian Pacific which occupies little more than one percent of the globe's land surface, but harbors one eighth of the world's mammal, bird, reptile, amphibian, and plant species. Most of Java's natural forests, and virtually all of its lowland rainforests, have been logged to support the 100 million people living there. Ujung Kulon constitutes the largest and most pristine natural ecosystem remaining on this biologically important island.

Some 40 mammal species are known to inhabit the Park. In addition to the Javan rhino, the Javan gibbon, two species of leaf monkey and the Javan tree shrew are found nowhere else in the world. Other important species include the flying lemur, banteng (a form of wild cattle), and several carnivore species such as the wild dog, leopard , binturong, small-toothed palm civet, Asian small-clawed otter and hairy-nosed otter.

More than 250 bird species are found in Ujung Kulon. Among the many species of interest to conservationists in this region are three types of hornbills, eight each of kingfishers and bulbuls, and ten of babblers. The green peafowl, green junglefowl and white-winged wood duck are also recorded.

The Park also shelters populations of many rare or threatened species of reptiles and amphibians, including most notably the green sea turtle and saltwater crocodile, and more than 50 rare species of plants.

How You Can Help

You can play a direct role in the Minnesota Zoo's efforts to protect Ujung Kulon National Park, the last refuge of the Javan rhino. The continued success of the Zoo's **Adopt-A-Park** program depends on your financial contribution.

In the first year, donations to the Minnesota Zoo Foundation and contributions from Steve Martin's "World of Birds Show" for this program totaled $25,000. These funds purchased a field communication system (complete with two-way radios, antennas, cables, boosters, speakers and solar power generators) for the guard posts, field bikes for patrolling the edge of the Park, two diesel marine engines and an ocean-going boat (built locally) for ferrying staff and supplies to remote areas, and smaller boats or canoes for patrolling in-land rivers.

Next year's contributions will be used to complete the purchase of field equipment for Park staff, and begin developing education materials for a local conservation outreach program. The third year will be devoted to expanding this program. Fund-raising goals for both years have been set at $25,000 per year.

This **Adopt-A-Park** program has attracted international attention for Ujung Kulon. The Zoo's initiative has rekindled World Wildlife Fund's long-term interest in the region, and the New Zealand government has also offered technical assistance to improve park management.

To help protect this threatened jungle, send your tax-deductible contribution to:

Minnesota Zoo Foundation
Adopt-A-Park
13000 Zoo Boulevard
Apple Valley, MN 55124 USA

Printed on recycled paper.

Ujung Kulon

Last Refuge of the Javan Rhino

An **Adopt-A-Park** Program of the Minnesota Zoo

In 1990, the Minnesota Zoo charted a new course for wildlife conservationists in zoos worldwide by "adopting" Ujung Kulon National Park in Java, Indonesia. Through this first-of-its-kind *in situ* (on location) conservation project, the Zoo provides direct assistance to the Indonesian Department of Nature Conservation's (PHPA) efforts to protect the unique and threatened ecosystem of Ujung Kulon, the last refuge of the Javan rhino.

Several features of the **Adopt-A-Park** program distinguish it from other zoo wildlife conservation initiatives:

- the program is based on a long-term commitment to support *in situ* conservation actions
- it emphasizes a grass-roots approach to give financial support directly to Park programs
- costs are modest, yet the program is having a major and immediate impact
- the program is not linked to bringing animals back to the Minnesota Zoo in return for our support

Why would the Minnesota Zoo concern itself with a conservation dilemma located half a globe away? This outreach program is a natural extension of the Zoo's conservation policy, which pledges to "support the preservation and restoration of endangered species' natural habitats."

Ujung Kulon is a perfect choice. In addition to the critically endangered Javan rhino, this national park provides refuge for several threatened wildlife species displayed in the Zoo's premiere exhibit, the Asian Tropics. Zoo staff also have considerable expertise in this region. Most compelling, this important area of biological diversity is in clear need of support.

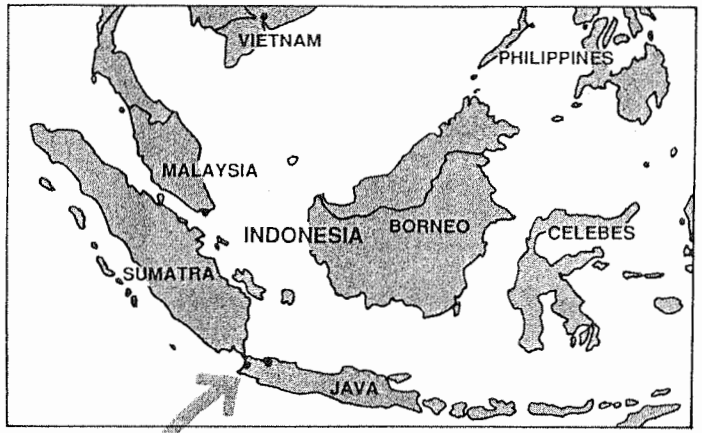
The Javan Rhino

Once ranging from Assam in northern India through much of Indochina, the Javan rhino had already disappeared from all but Java's Ujung Kulon peninsula by the turn of the last century. Less than 60 Javan rhinos are believed to exist in the world today, all in the swampy lowland forests of this small wilderness (one fourth the size of Yellowstone National Park) on the western tip of Java. A handful of animals may also persist in the jungles of southern Vietnam.

So severe were the pressures of human hunting and forest encroachment that some believe only the explosion of the volcano on nearby Krakatau Island saved this diminutive rhino species from total extinction. In the wake of the volcano's eruption in 1883, people shunned Java's western peninsula in fear of the great tidal waves that had devastated villages and crops. This respite lasted long enough for Ujung Kulon to receive official protection as a nature reserve in 1921, (expanded in 1980 to 300 square mile Ujung Kulon National Park).

Unfortunately, not even this last remote island population of the Javan rhino can be considered safe from extinction. Beyond the risks of natural disaster, genetic problems and disease that all small, isolated populations must face (five Javan rhinos succumbed to an unknown disease in 1982), the threat of poaching still looms large in Ujung Kulon. Poachers killed two rhinos in the Park as recently as 1985 and 1987.

The **Adopt-A-Park** program helps to protect this critically endangered species and its natural habitat.



A Model Program

The Minnesota Zoo's **Adopt-A-Park** program officially began in September 1990 when the Zoo entered into a formal agreement with Indonesia's PHPA to work together to protect the ecological stability of Ujung Kulon National Park, and thus ensure the long-term survival of the Javan rhino.

Reflecting the most urgent needs of the Park, the Zoo's first year goal in its three-year commitment was to assist PHPA in purchasing field communication and transportation equipment so that Ujung Kulon staff could more effectively guard against poaching. Next on the agenda is the development of education materials suitable for use in a conservation outreach program both for the Javanese people living on the borders of the Park and the 3,000 international tourists who visit Ujung Kulon each year. Future goals will be identified in cooperation with PHPA.

Recognizing the benefits and goodwill generated by this *in situ* program, the Sumatran Rhino Trust, a consortium of North American zoos working for the conservation of the Sumatran rhino, has decided to similarly support Kerinci National Park in northern Sumatra.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 9

TARGET POPULATION CALCULATIONS

SOUTHERN BLACK RHINO - WORLD POPULATION - CURRENT PARAMETERS

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):	1.030	Length of Program (Years):	100
% Diversity Retained to Date:	98.0	% Hetero. To Retain:	90.0
Effective Size of Population:	20.0		
Estimated Ne/N Ratio:	0.30	Growth rate per Generation:	1.56
Current Year:	5	# Generations during 100 Years:	6

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 100 Years: 46

Actual Population Size Required (Based on Ne/N Ratio): 153

=06/24/92========== j.ballou Feb'92 ===

Actual Population Sizes Required to Maintain 90.0% of the Original Heterozygosity for Effective Pop. Sizes Under Various Ne/N Ratios

EFFECTIVE POPULATION SIZE

Ne/N Ratio	20	25	30	35	40
0.10	460	390	370	360	350
0.20	230	195	185	180	175
0.30	153	130	123	120	117
0.40	115	98	93	90	88
0.50	92	78	74	72	70

Model Parameters

Lambda:	1.030
Gen. Length:	15.0
Program Length:	100
Het. to Date:	98.0
Years Elapsed:	5

Actual Population Sizes 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	125	150
0.10	180	350	460	750	1120
0.20	90	175	230	375	560
0.30	60	117	153	250	373
0.40	45	88	115	188	280
0.50	36	70	92	150	224

Model Parameters

Lambda	1.030
Gen. Length:	15.0
Effective Size:	20
Het. to Date:	98.0
Years Elapsed:	5

EASTERN BLACK RHINO - WORLD POPULATION - CURRENT PARAMETERS

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):	1.020	Length of Program (Years):	100
% Diversity Retained to Date:	97.0	% Hetero. To Retain:	90.0
Effective Size of Population:	29.0		
Estimated Ne/N Ratio:	0.20	Growth rate per Generation:	1.35
Current Year:	10	# Generations during 100 Years:	6

Effective Size Required to Maintain 90.0% of the
Original Founder's Heterozygosity for 100 Years: 45

Actual Population Size Required (Based on Ne/N Ratio): 225

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Actual Population Sizes Required to Maintain 90.0% of the Original
Heterozygosity for Effective Pop. Sizes Under Various Ne/N Ratios

EFFECTIVE POPULATION SIZE

Ne/N Ratio	30	35	40	45	50
0.10	440	420	400	400	400
0.20	220	210	200	200	200
0.30	147	140	133	133	133
0.40	110	105	100	100	100
0.50	88	84	80	80	80

Model Parameters

Lambda:	1.020
Gen. Length:	15.0
Program Length:	100
Het. to Date:	97.0
Years Elapsed:	10

Actual Population Sizes 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	125	150
0.10	200	350	450	720	1100
0.20	100	175	225	360	550
0.30	67	117	150	240	367
0.40	50	88	113	180	275
0.50	40	70	90	144	220

Model Parameters

Lambda:	1.020
Gen. Length:	15.0
Effective Size:	29
Het. to Date:	97.0
Years Elapsed:	10

EASTERN BLACK RHINO - WORLD POPULATION - IMPROVED BREEDING

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):	1.030	Length of Program (Years):	100
% Diversity Retained to Date:	97.0	% Hetero. To Retain:	90.0
Effective Size of Population:	29.0		
Estimated Ne/N Ratio:	0.30	Growth rate per Generation:	1.56
Current Year:	10	# Generations during 100 Years:	6

Effective Size Required to Maintain 90.0% of the
Original Founder's Heterozygosity for 100 Years: 44

Actual Population Size Required (Based on Ne/N Ratio): 147

=06/24/92========== j.ballou Feb'92 ===

Actual Population Sizes Required to Maintain 90.0% of the Original
Heterozygosity for Effective Pop. Sizes Under Various Ne/N Ratios

EFFECTIVE POPULATION SIZE

Ne/N Ratio	30	35	40	45	50
0.10	430	420	400	400	400
0.20	215	210	200	200	200
0.30	143	140	133	133	133
0.40	108	105	100	100	100
0.50	86	84	80	80	80

Model Parameters

Lambda:	1.030
Gen. Length:	15.0
Program Length:	100
Het. to Date:	97.0
Years Elapsed:	10

Actual Population Sizes 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	125	150
0.10	200	350	440	650	890
0.20	100	175	220	325	445
0.30	67	117	147	217	297
0.40	50	88	110	163	223
0.50	40	70	88	130	178

Model Parameters

Lambda:	1.030
Gen. Length:	15.0
Effective Size:	29
Het. to Date:	97.0
Years Elapsed:	10

INDIAN RHINO - WORLD POPULATION - CURRENT DEMOGRAPHIC/GENETIC PARAMETERS

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):	1.020	Length of Program (Years):	100
% Diversity Retained to Date:	92.8	%Hetero. To Retain:	90.0
Effective Size of Population:	25.0		
Estimated Ne/N Ratio:	0.40	Growth rate per Generation:	1.35
Current Year:	10	# Generations during 100 Years:	6

Effective Size Required to Maintain 90.0% of the
Original Founder's Heterozygosity for 100 Years: Not Possible With

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

=06/23/92========== j.ballou Feb'92 ===

Actual Population Sizes Required to Maintain 90.0% of the Original
Heterozygosity for Effective Pop. Sizes Under Various Ne/N Ratios

EFFECTIVE POPULATION SIZE

Ne/N Ratio	20	25	30	35	40
0.10	****	****	****	****	****
0.20	****	****	****	****	****
0.30	****	****	****	****	****
0.40	****	****	****	****	****
0.50	****	****	****	****	****

Model Parameters

Lambda:	1.020
Gen. Length:	15.0
Program Length:	100
Het. to Date:	92.8
Years Elapsed:	10

**** = Not Possible with these parameters

LENGTH OF PROGRAM (YEARS)

Ne/N Ratio	50	75	100	125	150
0.10	****	****	****	****	****
0.20	****	****	****	****	****
0.30	****	****	****	****	****
0.40	****	****	****	****	****
0.50	****	****	****	****	****

Model Parameters

Lambda:	1.020
Gen. Length:	15.0
Effective Size:	25
Het. to Date:	92.8
Years Elapsed:	10

**** = Not Possible with these parameters

INDIAN RHINO - WORLD POPULATION - IMPROVED BREEDING & HIGHER GENE DIVERSITY

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):	1.04	Length of Program (Years):	100
% Diversity Retained to Date:	95.0	% Hetero. To Retain:	90.0
Effective Size of Population:	25.0		
Estimated Ne/N Ratio:	0.40	Growth rate per Generation:	1.80
Current Year:	10	# Generations during 100 Years:	6

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 100 Years: 91

Actual Population Size Required (Based on Ne/N Ratio): 228

=06/23/92========== j.ballou Feb'92 ===

Actual Population Sizes Required to Maintain 90.0% of the Original Heterozygosity for Effective Pop. Sizes Under Various Ne/N Ratios

EFFECTIVE POPULATION SIZE

Ne/N Ratio	20	25	30	35	40
0.10	****	910	720	630	600
0.20	****	455	360	315	300
0.30	****	303	240	210	200
0.40	****	228	180	158	150
0.50	****	182	144	126	120

**** = Not Possible with these parameters

Model Parameters	
Lambda:	1.040
Gen. Length:	15.0
Program Length:	100
Het. to Date:	95.0
Years Elapsed:	10

Actual Population Sizes 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	125	150
0.10	300	660	910	1530	2300
0.20	150	330	455	765	1150
0.30	100	220	303	510	767
0.40	75	165	228	383	575
0.50	60	132	182	306	460

Model Parameters	
Lambda:	1.040
Gen. Length:	15.0
Effective Size:	25
Het. to Date:	95.0
Years Elapsed:	10

CAPACITY
Version 3.0 (Quicksilver)
February, 1992

J. Ballou
National Zoological Park
(202) 673-4815

GENERAL DESCRIPTION:

CAPACITY Version 3.00 is a Quicksilver Compiled dBASE program to calculate the captive population size needed to maintain desired amounts of heterozygosity (e.g. 90%) for specified time periods (e.g. 200 years) given the population's current status. The concept of defining population size objectives using goals for maintaining heterozygosity is discussed by M. Soul┼, M. Gilpin, W. Conway and T. Foose in "The millennium ark: how long a voyage, how many staterooms, how many passengers?", Zoo Biology 5:101-114, 1986.

The program models the theoretical growth of a population from its current status to the end of the time period. The population is grown in discrete generation length (T) time periods (at the rate of λ^T) until it reaches a size that, if maintained at that size (K) for the rest of the program length, will allow it to maintain the desired amount of genetic diversity. Once at K, the population experiences no further growth (see Figure 1).

In order to make these calculations using the population's current status, it is necessary to know how much of the diversity has already been lost and how many years have already passed to determine how much of the current diversity needs to be retained in the remaining time.

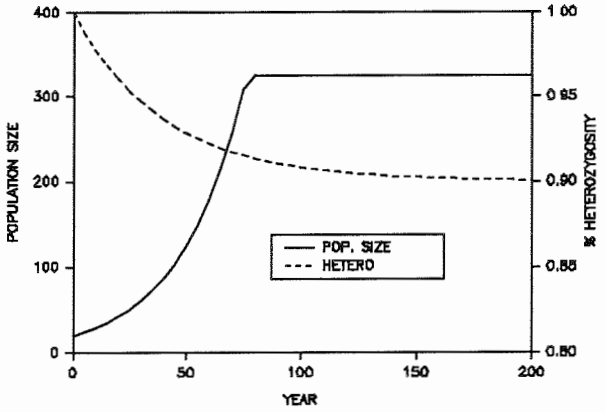

Figure 1: This population needs to grow to about 325 animals to maintain 90% of its original heterozygosity.

Depending on the current status of the population, four different scenarios may result:

1) Further growth of the population is required and a realistic target size is attainable given the parameters entered (as in Figure 1).

2) The current population size exceeds (or is exactly at) the number needed. The model does not impose further growth on the population. Rather, λ is ignored and the actual reduced number of animals required is calculated.

3) The heterozygosity goal is achievable given the current parameters but the required number of animals may be greater than can be realistically managed (> 9999) (Figure 2). If this is the case, the program reports "*** = Not possible with these parameters". To reduce the number of animals required, you can improve the conditions by increasing the growth rate, the effective size of the current population, the generation time, or the amount of heterozygosity retained to date. Alternatively (or in addition), you can decrease the length of the program, and/or the % heterozygosity to be retained.

4) Given the current parameters and maximum growth, heterozygosity still drops below the target level before the time period ends (Figure 3). The program returns the message "**** = Not possible with these parameters." The parameters are insufficient to retain enough heterozygosity. To retain the desired amount of heterozygosity, use the same solutions mentioned in scenario 3.

The calculations are based on data from the population as well as the goals of the program. The data required to run the program are:

STATUS OF THE POPULATION:
Generation Length
Maximum Likely Growth Rate
Current Effective Population Size
N_e/N Ratio
Heterozygosity Retained to Date
No. of Years Since the Beginning of Program

PROGRAM OBJECTIVES:
Length of the Program
% of Original Heterozygosity to Retain

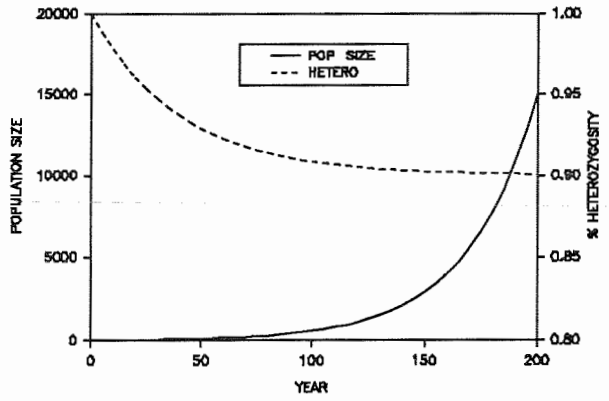

Figure 2: Population size required to maintain 90% of the original heterozygosity exceeds realistic numbers.

CAPACITY 3.00 Changes: This version takes into consideration the loss of diversity that has already occurred in the population. Previous versions modeled the population only from its founding event. This version also allows output to be written to files, as well as the printer.

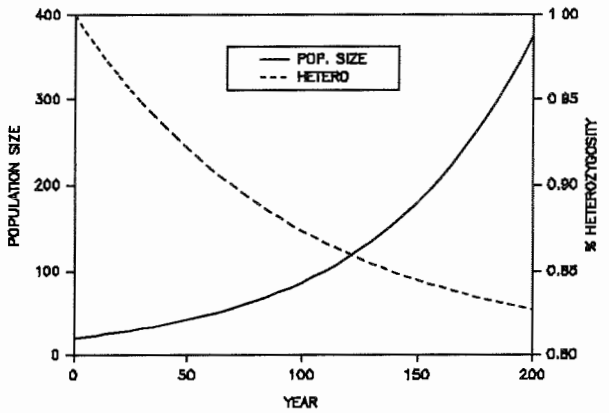

Figure 3: Heterozygosity drops below target (90%) before program ends, despite maximum growth of the population.

INSTRUCTIONS AND OPTIONS:

The only required file is CAPACITY.EXE. Type "CAPACITY" at the DOS prompt to begin the program. Provide the following information:

Generation Length (in years): Defined as the average age at which a breeder produces young. Enter a value between 1 and 99.

Annual Growth Rate (λ): The factor which when multiplied to one year's population size results in the following year's population size. $\lambda = 1.00$ results in no growth. Values less than 1 are negative growth, values greater than one are positive growth. λ values less than 1.00 (negative population growth) can not be used in the model: questions of maintaining genetic diversity are moot because the population will go extinct. Enter the λ that best represents the maximum realistic growth rate achievable by the population.

Effective Size of Current Population: Enter the effective size (N_e) of the current population. This is difficult to estimate. As a very rough estimate, (likely to be an underestimate), you can use the following formula with the number of living males (N_m) and females (N_f) that are proven breeders to calculate the effective size:

$$N_e = \frac{4 \times N_f \times N_m}{N_f + N_m}$$

The program uses this effective size, rather than the actual size, to model loss of genetic diversity.

Estimated N_e/N ratio: The ratio of the effective population size to the real population size. This theoretically ranges between 0 and almost 2.0 but is realistically rarely over 1.0. This ratio will be applied over the entire history of the modeled population. Enter what you think is a reasonable ratio under future population management.

Heterozygosity Retained to Date: Enter the gene diversity or expected heterozygosity of the current population. This should be entered in terms of the % of the original heterozygosity brought in by the population's founders. This can be calculated from the population's pedigree using GENES or similar pedigree analysis software. If the current population consists only of the founders, heterozygosity retained to date is 100%.

% Heterozygosity To Be Retained: Enter the percent of heterozygosity to be retained over the time period of the population's management. Try 90% as a starting point (see the Soul+ et al. reference mentioned above).

Number of Years Since Program Began: Enter how many years have elapsed since the initiation of the program. If the current population is the founders, enter 0. This will be used to determine how many years remain in the program.

Length of Program: The duration of the captive breeding program in years. 200 years is often used as a starting point (see the Soul+ et al. reference mentioned above). Note that the program need not necessarily start with the current population since the program may have already been in effect for several years.

These definitions are also provided on screen by pressing "D" from the menu that appears at the bottom of the screen after values are entered.

RANGE TABLES:

Range Tables allow the user to vary two different parameters at the same time to calculate target population sizes for a variety of conditions. See the example at the end of this documentation.

MODEL LIMITATIONS:

1) Does not allow for migrants - all founders are assumed to enter the population at the beginning of the program (generation 0).

2) Allows for only one N_e/N ratio which is applied to both the current population and future population sizes. Therefore, it does not consider any changes in N_e/N once the population reaches its target size. This is likely to be unrealistic: N_e/N ratios can be drastically different when a population is managed for zero population growth.

EXAMPLE:

Capacity 3.0

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

No. of Years per Generation (T):	6.0	**PROGRAM GOALS:**	
Annual Growth Rate (lambda):	1.250	Length of Program (Years):	200
Estimated Ne/N Ratio:	0.30	% Hetero. To Retain:	90.0
Effective Size of Population:	34.0		
% Diversity Retained to Date:	97.5	Growth rate per Generation:	3.81
Current Year:	7	# Generations during 200 Years:	33

Effective Size Required to Maintain 90.0% of the Original Founder's Heterozygosity for 200 Years: 244

Actual Population Size Required (Based on Ne/N Ratio): 813

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EXAMPLE OF RANGE TABLE OPTION VARYING LENGTH OF PROGRAM AND POPULATION'S EFFECTIVE SIZE:

Capacity 3.0

ACTUAL POPULATION SIZES Required to Maintain 90.0% of the Original Heterozygosity for Various Time Periods Given Various Ne Sizes

		LENGTH OF PROGRAM (YEARS)				
		50	75	100	150	200
Population's Effective Size	30	160	263	370	623	850
	40	150	247	347	573	780
	50	147	240	333	550	743
	60	147	233	327	537	720
	70	147	230	320	527	710

Model Parameters

Lambda:	1.250
Gen. Length:	6.0
Ne/N Ratio:	0.30
Het. to Date:	97.5
Years Elapsed:	7

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RHINO

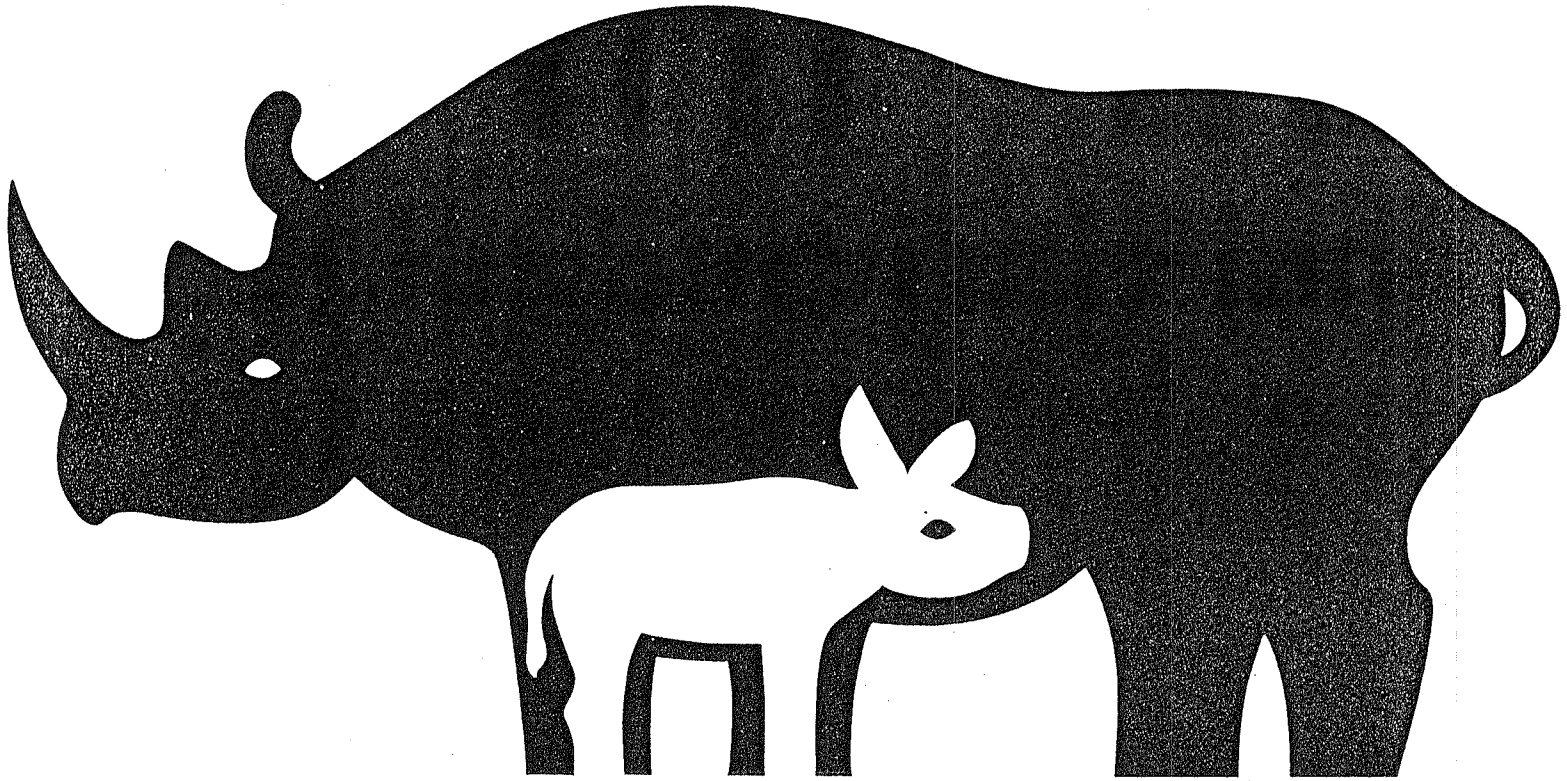
GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 10

REGIONAL PROPAGATION PROGRAMS



Regional Captive Propagation Programs

AMERICAN ASSOCIATION OF ZOOLOGICAL PARKS AND AQUARIUMS
A·A·Z·P·A 1924

AAZPA ANNUAL REPORT

on conservation and science

AAZPA
ANNUAL REPORT ON
CONSERVATION AND SCIENCE
1990-91

Edited by

Michael Hutchins, Ph.D.
Director of Conservation and Science

Robert J. Wiese, Ph.D.
Conservation Biologist

Kevin Willis, M.S.
Conservation Biologist

Stacey Becker, B.A.
Program Assistant

Cover and Illustrations by

John Buettner
Oklahoma City Zoological Gardens

First Edition
1991

RHINOCEROS ADVISORY GROUP

Chair:
Robert W. Reece, Wild Animal Habitat, Kings Island

Primary Goals

The AAZPA Rhinoceros Advisory Group was officially recognized in January 1991 by the AAZPA's Wildlife Conservation and Management Committee (WCMC). While still in the formative stages, the group has the following long-term objectives: (1) to establish a regional management plan for rhinos which focuses on the efficient use of existing resources, the development of new resources, and the encouragement of effective relationships with other regional breeding programs (e.g., EEP, ASMP, etc.); (2) to develop strategies for the support of *in situ* conservation efforts through increased communication and interaction between SSP institutions, range country managers, NGO's and field scientists; (3) to identify research priorities and assist in the development and implementation of an aggressive research program with specific objectives in those areas of greatest concern; (4) to maintain current information on the status of all captive and wild rhino populations; and (5) to assess the implementation of all rhino SSP Master Plans and provide assistance wherever possible.

Data Table

	Current year
# of meetings	0
# of studbooks under umbrella	4
# of SSPs under umbrella	4
# of new studbook petitions submitted	0
# of new studbooks approved	0
# of new SSP petitions submitted	0
# of new SSPs approved	0

Special Concerns

It has become increasingly apparent that there is a real need to facilitate communication among and between people and programs involved with rhino conservation. Many are convinced that there are conflicting and competing agendas at work and that to support one aspect or approach necessarily detracts from another. Misinformation concerning the efficacy of the various approaches, especially captive breeding, needs to be eliminated. The AAZPA Rhino Advisory Group will use *Around The Horn, The Rhino Conservation Newsletter* to disseminate factual information and serve as a conduit through which individuals and institutions can communicate with everyone involved in the preservation of rhinos.

There must be a concerted effort to increase the amount of resources available to rhino conservation, especially in terms of money and space. While space allocation can be more efficient, the cost of developing and maintaining rhino programs such as research and *in situ* projects will be considerable. As a result, methods will have to be developed to provide these resources.

Progress Toward Goals

(1) The Rhino Advisory Group is in it's formative stages and has only begun to develop specific long- and short-range objectives. The membership selection process is nearly complete and is intended to be flexible so as to allow for the greatest influx of ideas and discussion.

(2) A Rhino strategic planning meeting was held at the New York Zoological Park in July 1991. Much progress was made in identifying major concerns and in outlining various programmatic needs. An additional meeting will be held in connection with the 1991 AAZPA Annual Conference in San Diego.

Short-term Goals for Upcoming Year

(1) Complete an assessment of captive holding space and how it is currently allocated in the North American region.

(2) Initiate an assessment of the rhino husbandry and management practices in institutions holding black and white rhinos.

(3) Formalize a research subcommittee and charge it with the responsibility of developing an aggressive research strategy designed to assist in the veterinary, husbandry and reproductive management of rhinos.

(4) In conjunction with the CBSG Rhino Captive Action Plan Working Group, initiate a concerted effort to address and resolve the black rhino subspecies question.
(5) Begin the development of a unified Regional Collection Plan for all rhinos under the TAG umbrella.

BLACK RHINOCEROS (*Diceros bicornis michaeli* and *D. bicornis minor*)

Species Coordinator: Edward J. Maruska, Cincinnati Zoo and Botanical Garden
Subspecies coordinator: Don Farst, D.V.M., Gladys Porter Zoo
International Studbook Keeper: H.G. Kloss, Berlin Zoo

Introduction

Population genetic analyses have shown that the minimum viable population size (MVP) for black rhinos necessary to maintain 90% of original genetic diversity for 200 years is 150 animals split up into 75 *michaeli* and 75 *minor*. At the present time, there are 67 *michaeli* in 23 institutions and 19 *minor* in seven institutions for a total of 86 animals in 30 institutions in North America. Even though the goal is to preserve 90% of the average heterozygosity in the gene pool for 200 years, in the case of the black rhino, there seems to be some "intuitive logic" in modifying this objective in terms of rhino generations; 10 rhino generations would represent 150-170 years.

At present growth rates, *michaeli* , with a population of 67, should be expected to reach the target "carrying capacity" of 75 in about five years. With a current population of *minor* at 19, it will obviously be some time before the SSP population can attain its target "carrying capacity" of 75. The black rhino SSP is in the mature stage.

In summary, the long-term goals of the Black Rhino SSP are: (1) to propagate black rhino in North America to reinforce wild populations in Africa as part of the IUCN global strategy; (2) toward this goal, to attempt to preserve 90% of the average heterozygosity obtained from wild populations for a period of at least 170 years (10 black rhino generations) and perhaps longer; (3) to respect, at least initially, the four geographical varieties and potential e.s.u.'s recognized by the 1986 Cincinnati African Rhino Workshop; (4) to develop an SSP population of 150 black rhino in North America; (5) to expand the captive habitat for black rhino in North America and emphasize reproduction of black rhino in the management recommendations to insure the self-sustainment and expansion of the captive population against the appreciable mortality still occurring.

Data Table (current through 1 July 1991)

D.b. michaeli

	One year ago	Current year
Participating institutions	22	23
Captive Population	31.35	31.36
# SSP animals managed	66	67
# SSP animals not required to meet goals	0	0
# animals in non-participant collections but desirable to SSP	2	2
Total births in SSP program	5	1
# surviving to one year	4	1
# of desired births	5	1
# of undesired births	0	0
# of deaths of SSP animals	2	1
# of imports	0	0
# of exports	0	0
# of founders with represented descendants	78	78

D.b. minor

	One year ago	Current year
Participating institutions	7	7
Captive Population	7.12	7.12
# SSP animals managed	19	19
# SSP animals not required to meet goals	0	0
# animals in non-participant collections but desirable to SSP	0	0
Total births in SSP program	1	1
# surviving to one year	1	0
# of desired births	1	1
# of undesired births	0	0
# of deaths of SSP animals	0	1
# of imports	0	0
# of exports	0	0
# of founders with represented descendants	11	11

Current Population Status

The population of *michaeli* is approaching the proposed MVP of 75 animals as it currently numbers 67. The birth rate is minimum at best with an increase of only three animals in 1990 and one born in 1991 to date. Because the black rhino population in the wild dropped 85% in only thirty years, from 60,000 in 1960 to under 3,000 today, more emphasis needs to be focused on captive breeding in order to increase the birth rate for both *michaeli* and *minor*. In 1990, only one *minor* was born and in 1991, to date, only one has been born but it died the same day. There have been no imports or exports in 1990-1991. All black rhinos in the population are SSP non-surplus animals and two *michaeli* in the Mexico City Zoo have not been included in the North American population because they have not signed a Memorandum of Participation. The population size of *minor* needs to be increased.

Demographic Trends

The Black Rhino SSP is attempting to manage two of the four potential evolutionarily significant units (e.s.u.'s) for black rhino: *michaeli* and *minor*. Reproduction is occurring as explained above, but at a slower rate than is desirable. There have been no recommendations made to remove any animals from the breeding population. The Black Rhino Master Plan has been closely followed and almost every recommendation has been quickly accomplished.

Population Genetics

The addition of ten new founders of *minor* for the North American population is being planned through the International Black Rhino Foundation agreement with the Zimbabwean government. The U.S. Fish and Wildlife Service received a permit number on 1 July 1991 and it is anticipated that they will issue the permit by October. At the present time there are only 11 founders with represented descendents of *minor* in the North American population. There is an ongoing effort to increase founder representation. In Malaysia at Zoo Negra there is an adult male *michaeli* that may become available for import (in exchange for a pair of white rhino) and there is a 15 year-old female *michaeli* at the Buenos Aires Zoo, Argentina that may be available (in exchange for a young pair of black rhino).

Special Concerns

The population of *minor* needs to be increased and currently there is a dearth of space for *michaeli* which may have an eventual impact on space for *minor*. The Black Rhino SSP has been working with the White Rhino SSP in hopes of moving white rhino from selected institutions to open up more space for black rhino. The Black Rhino SSP may be forced to send some animals out of the U.S. in order to solve this problem. Presently there is a request from the San Diego Zoo to send a male to Japan. This male will probably be sent with the prerequisite that the Yokohama Zoo participate in the SSP. The question of whether or not to keep *michaeli* and *minor* as two subspecies still begs an answer and genetic analyses are ongoing even though there are no apparent morphological differences. Also, biochemical analyses to date have not yet demonstrated any differences between *michaeli* and *minor*.

It will be extremely important to evaluate and determine, over the next five years, the nutritional requirements for captive black rhino.

Research

Current research involves reproduction studies such as hormonal evaluations of urines, bloods, saliva, feces; ultrasound evaluations for pregnancy, ovarian observations and anatomy; semen freezing; anatomical studies at necropsy; development of instrumentation for embryo transfer; nutritional studies involving vitamin E; and disease related studies. There needs to be an increased focus on nutritional studies and problems involving diseases such as hemolytic anemia.

Field Conservation

The International Black Rhino Foundation agreement with the Zimbabwean government will help support field operations in Zimbabwe. Monies raised from the efforts of Michael Werikhe as he walks across the U.S. will benefit black rhino conservation in Africa.

Progress Toward Goals

(1) Completion of negotiations (through the Black Rhino Foundation) with the Zimbabwean government to obtain 10 new founders for the SSP population.

Short-term Goals for Upcoming Year

(1) Make all recommended transfers. The proposed number of *michaeli* transfers during the upcoming year should be approximately six or more depending upon numbers of births and sexes of calves.
(2) Attempt to breed to conception all recommended females.
(3) Make and communicate recommendation to wean calves as soon as possible to be able to expose post-lactational cows to bulls.
(4) Carefully evaluate management of new *minor* founders so that the entire population will be enhanced.
(5) Seek more space for both *michaeli* and *minor* in order to achieve the MVP of 150 animals.

GREATER ONE-HORNED RHINOCEROS (*Rhinoceros unicornis*)

Species Coordinator: Michael Dee, Los Angeles Zoo
International Studbook Keeper: Kathleen Tobler, Basel Zoo, Switzerland

Introduction

There are currently 12 institutions participating in the Greater One-horned or Indian Rhinoceros SSP. However, only seven institutions are breeding this species due to the fact that two have single animals, two have animals that have not yet reached sexual maturity and one has a newly acquired male that has yet to breed.

Population genetic analysis has shown that the minimum viable population size (MVP) in order to maintain 90% of original genetic diversity for 200 years is approximately 294 animals, about eight times the current population size in North America. Under these conditions, each participating institution would need to allocate space for 24 animals. Even if the current number of participating institutions was doubled, 12 animals would have to be maintained at each in order to meet the SSP's goals.

At the 1989 Master Plan session, a more realistic approach of maintaining 50 animals was discussed. Ideally, at least 84 animals will need to be maintained through births and importations to meet the minimum objectives of the SSP.

Data Table (current through 1 January 1991)

	One year ago	Current year
Participating institutions	12	12
Captive Population	150	155
# SSP animals managed	34	36
# SSP animals not required to meet goals	1	0
# animals in non-participant collections but desirable to SSP	-	-
Total births in SSP program	22	22
# surviving to 1 yr.	13	13
# of desired births	3	1
# of undesired births	0	0
# of deaths of SSP animals	-	-
# of imports	2	0
# of exports	1	0
# of founders with represented descendants	14	14

Current Population Status

At present, the SSP population appears to be somewhat secure. Competition with other rhino species has occurred, but does not appear to be serious at this time. At the 1989 Master Plan session, future breeding, surplus and management priorities were discussed. Another meeting is planned for early 1992.

There are no non-SSP animals in North America. The wild population appears to be somewhat stable, although poaching has occurred in India (present population about 1500) and the Nepal population in Chitwan National Park is expanding by about 10% per year. Forty-three animals have been translocated from Chitwan to the Royal Bardia National Park in the past three years. The species coordinator is working with the Nepalese government to obtain at least six more founder animals for the SSP.

Demographic Trends

Life history table analysis of the North American studbook population indicates a growth rate (r) of 1.043, a generation time (T) of 17.5 years, a rate of population increase per generation (R_O) of 2.122, and a life expectancy at birth of 20 years. The Greater One-horned Rhino SSP population has grown at the annual rate of 1.3 animals per year since 1982. All recruitment has been through births and two importations (1987 and 1990). The San Diego Wild Animal Park recorded three births in 1990.

Population Genetics

Inbreeding coefficients (ICs) for each living animal have been calculated. There are several founder animals with ICs of 0.22000. If the founder population is to effectively meet the SSP's goals, then 6-8 new founders need to be brought into the SSP.

Research

Research into rhino reproduction is ongoing at a number of facilities, notably the Cincinnati Zoo, San Diego Zoo and National Zoological Park. Nutritional research is also a priority, particularly as it relates to Vitamin E levels in captive animals.

Short-term Goals for Upcoming Year

(1) Update the Master Plan.
(2) Pair single animals where possible.
(3) Encourage research on rhino nutrition, especially as it relates to Vitamin E.
(4) Encourage more institutions to become participants in the SSP. At present, three institutions have expressed interest in joining if animals become available.

SUMATRAN RHINO (*Dicerorhinus sumatrensis*)

Species Coordinators: James Doherty, New York Zoological Park
International Studbook Keeper: Thomas Foose, Ph.D., IUCN CBSG

Introduction

In 1985, the New York, Cincinnati, San Diego and Los Angeles Zoos established a cooperative agreement with the Indonesian government. Thus, the Sumatran Rhino Trust and SSP was born to help ensure the survival of this rapidly declining species. Currently, there are four animals in North America with an agreement from the Indonesians to establish breeding groups both in the United States and Indonesia.

Data Table (current through 1 July 1991)

	Two years ago	One year ago	Current year
Participating institutions	4	3	4
Captive Population	5	13	24
# SSP animals managed	0.3	0.3	1.3
# SSP animals not required to meet goals	0	0	0
# animals in non-participant collections but desirable to SSP	-	-	-
Total births in SSP program	0	0	0
# surviving to one year	-	-	-
# of desired births	-	-	-
# of undesired births	-	-	-
# of deaths of SSP animals	0	0	0
# of imports	3	0	1
# of exports	0	0	0
# of founders with represented descendants	-	-	-

Current Population Status

SSP population levels are still quite low as we continue to assemble the breeding nucleus of 10 (5.5) founders. This fall, the male which currently resides with the female in San Diego, will be moved to the Cincinnati Zoo. In the captive population outside of North America, only one birth has occurred in the Malacca Zoo to a female who was captured during pregnancy. This lack of reproduction may be attributable to skewed sex ratios in nearly all the Southeast Asian facilities. Port Lympne in England has 1.1 animals. The female there seems to have experienced an unsuccessful pregnancy but no full-term births have occurred to date. The female in the Jakarta Zoo may be pregnant as a result of a breeding that occurred at the end of 1990.

Demographic Trends

In the last 12 months, field capture has progressed much more smoothly and two additional females are waiting for export to North America. They will arrive in August or September. There is a pressing need to get more males into the North American population.

Population Genetics

The 10 (5.5) founders currently sought for North America are still below an ideal minimum. Eventually, either more founders will be required from the wild or from the captive population outside of North America.

Special Concerns

An important consideration in regard to eventual exchanges is the subspecies issue. Sumatran rhinos are separated into three geographically isolated subspecies from Borneo, Sumatra and Peninsular Malaysia. Geographical separation suggests that evolutionary divergence could have taken place. Genetic studies by the New York Zoological Society are currently in progress, specifically to determine whether or not significantly large genetic differences among the subspecies justify their maintenance as separate populations.

Research

An Asian Rhino Conservation Workshop, to be held in Bogor, Indonesia in October 1991, will address research and conservation of the Sumatran and Javan rhinos.

Field Conservation

The survey and salvage operation in Sumatra continues. Poaching is still a serious problem for this species.

Progress Toward Goals

(1) Three additional animals, including one male, have been captured this year, pushing us beyond the half-way mark for completing our breeding nucleus of ten animals.
(2) Two rhinos (1.1) are to be transferred from Sumatra to Java for pairing with animals in collections there.

Short-term Goals for Upcoming Year

(1) Facilitate breeding by all existing females in the SSP population.
(2) Complete capture and translocation operation in Sumatra.
(3) Attend and participate in the Asian Rhino Conservation Workshop in Bogor, Indonesia in October 1991.

WHITE RHINOCEROS (*Ceratotherium simum simum*)

Species Coordinator and Studbook Keeper:
Robert W. Reece, Wild Animal Habitat, Kings Island

Introduction

The overall objective of the southern white rhino SSP is to develop a captive self-sustaining population to reinforce the wild populations in Africa as part of a global strategy. To that end, we will attempt to preserve 90% of the average heterozygosity obtained from the wild populations for a period of 170-200 years or 10-12 white rhino generations. Since there is a need to coordinate the use of resources by all of the rhino SSP programs, the southern white population will be reduced gradually over the next several years to approximately 100 individuals. Accomplishing this reduction will require that we also attain a minimum of 35 effective founders in order to achieve the demographic and genetic goals mention earlier.

The white rhino program was blessed initially with an unusually large number of potential founders as a result of the large influx of importations which occurred in the late 1960s and early 1970s. Unfortunately, most of these very young animals were placed as pairs where they remained into adulthood. A recently completed analysis of these animals indicates that none of the animals so placed has reproduced in it's original location. With one exception, the same holds true for animals placed as trios. Institutions with multiple male/multiple female groups have invariably experienced breeding success. Since there is a limited number of facilities large enough to accommodate these groups, the SSP has endeavored to induce breeding by translocating specific animals. This usually has involved switching males between "pair" institutions and moving previously non-breeding animals to institutions which have enjoyed successful programs in exchange for animals that are sufficiently represented, at least for the near term. In terms of increasing founder representation, the white rhino SSP is still developing even though we have, through attrition, reduced the total number of animals currently managed by the SSP.

Data Table (current through 1 December 1990)

	Two years ago	One year ago	Current year
Participating institutions	48	41	40
Captive Population	61.75	58.74	58.70
# SSP animals managed	136	132	124
# SSP animals not required to meet goals	0	0	4
# animals in non-participant collections but desirable to SSP	0	0	0
Total births in SSP program	7	2	3
# surviving to one year	7	1	3
# of desired births	7	2	3
# of undesired births	0	0	0
# of deaths of SSP animals	3	3	3
# of imports	0	0	0
# of exports	1	1	8
# of founders with represented descendants	36	36	37

Current Population Status

The captive white rhino population is currently being reduced through attrition and by exporting selected animals to the new Australasian program. Several non-productive animals have been placed in breeding situations and in some cases given reproduction examinations to determine their value to the SSP. There are indications that animals which have not bred by the time they are in excess of 25 years of age, probably will not breed. In 1988 and 1989, 34 potential founders were transferred to new locations in an attempt to stimulate breeding. The success of that project has not been determined as yet.

Demographic Trends

Reproduction has fallen off during the past two years primarily due to the translocation program which has taken some of the more prolific breeders out of circulation. Additionally, we are attempting to insure that we don't produce surplus animals. Australia is still in need of more white rhinos but the animals which

are producing are well represented in the Australasian program. The population has remained stable, growing at a rate of slightly less than two percent if exports and planned surpluses are discounted. However, the population is aging and emphasis will soon need to be shifted to producing second generation offspring.

Population Genetics

While the current founder base is probably adequate, the fact that the remaining potential founders are approaching 25-30 years of age means that unless the transfers mentioned above provide sufficient stimuli to induce breeding in the very near future there is little likelihood that the founder base will increase perceptibly.

Special Concerns

As was mentioned earlier, in the late 1960s and early 1970s many of the imported white rhinos were placed as young pairs in zoos which could not accommodate larger groups. None of these animals ever bred in their original locations. The situation was nearly as bad for animals placed as trios. Institutions where animals were received in larger multiple male/multiple female groups invariably experienced breeding success. Much of the emphasis in the Master Plan has been placed on attempting to move animals previously kept in pairs or unproductive trios into breeding groups. Cooperation in this respect has been good and the effort is ongoing. However, some institutions are reluctant to transfer animals because of the costs involved.

Research

Research efforts have been sporadic and have emphasized primarily the need to gather reproductive data (on all species of rhino). It is anticipated that within the coming months the Rhino TAG will produce a set of priorities for research and provide the leadership necessary to develop a comprehensive program in which many institutions will be able to participate.

Short-term Goals for Upcoming Year

(1) There are still eight animals which have been recommended for transfer and it is anticipated that at least four of these transfers will occur during the coming year.

(2) A space allocation study already underway will be completed. This analysis will result in recommendations for each individual institution regarding what the propagation group feels is that institution's role in rhino captive breeding. It is expected that many of those facilities which only have accommodations for a pair of animals will be asked to consider switching to another species of rhino or to expand their facilities to accommodate a larger group of whites.

AAZPA
ANNUAL REPORT ON
CONSERVATION AND SCIENCE
1991-92

Edited by

Michael Hutchins, Ph.D.
Director of Conservation and Science

Robert Wiese, Ph.D.
Assistant Director of Conservation and Science

Kevin Willis, M.S.
Conservation Biologist

Stacey Becker, B.A.
Program Assistant

Cover and Illustrations by

John Buettner
Oklahoma City Zoological Gardens

1992

RHINOCEROS ADVISORY GROUP

Chair:
Robert W. Reece, The Wilds

Primary Goals

Recognizing that the ultimate objective of captive breeding and related scientific efforts is to preserve wild populations, and that the preservation of wild populations requires the protection and management of habitat and the commitment of people and the governments of the range countries affected, it is the mission of the AAZPA Rhino Advisory Group to: (1) support and/or initiate basic and applied research which contributes to the management and conservation of rhinos, both *in situ* and *ex situ*; (2) strengthen field conservation efforts by developing and exporting useful management technologies; (3) develop, maintain, and use sustainable captive populations of rhinos to insure that animals will be available to augment existing or reestablish extirpated wild populations as needed; (4) promote communication and sharing of information between individuals and organizations working in rhino conservation worldwide; and (5) encourage our member institutions to support *in situ* conservation efforts whenever possible.

Data Table (current through 1 July, 1992)

	One year ago	Current year
# of meetings this year	0	3
# of studbooks under umbrella	4	4
# of SSPs under umbrella	4	4
# of new studbooks petitions submitted	0	0
# of new studbooks approved	0	0
# of new SSP petitions submitted	0	0
# of new SSPs approved	0	0

Special Concerns

Of particular concern to the Rhino Advisory Group is not only the development of self-sustaining captive populations of the various rhino taxa, but the further development of the technology and methods necessary to make these populations truly useful in supporting *in situ* populations. Much needs to be accomplished to increase our knowledge of the behavioral, nutritional and physiological requirements. Assisted reproduction technology holds great promise in helping to manage both *in situ* and *ex situ* populations and to facilitate the flow of genetic material between small and/or remnant groups.

The communication of information and ideas among the regions and between the *in situ* and ex *situ* communities remains paramount. Discussions have been held to focus on methods which may be useful in facilitating the flow of information. During a recent meeting of the Rhino Advisory Group, members expressed the need for more emphasis on personal approaches instead of waiting for meetings and publications.

Finally, there is a critical need to raise funds to support the efforts being made or which need to be made on behalf of the rhino. Finding solutions to such devastating medical conditions as hemolytic anemia requires that financial resources be identified to support those working on the problems. Nutrition and reproduction studies must be conducted as well as the need for funding *in situ* projects.

Progress Toward Goals

(1) In it's first year, the Rhino TAG held three meetings. The first general meeting at the San Diego AAZPA annual meeting was intended largely as organizational and provided a forum for identifying the mission and objectives of the TAG and assigning a limited number of tasks. A second meeting of a subcommittee of the entire membership was held in Cincinnati in the Spring of 1992 in order to develop input for the Global Action Plan meetings in London and to begin work on developing management strategies for the regional plan. Finally, another subcommittee met at White Oak Plantation to begin work on a husbandry manual for all of the rhino taxa.

(2) A research committee has been established to identify and prioritize objectives and to develop a plan for their implementation.

(3) Participation with representatives of the other regions in developing a global action plan for rhinos helped to focus the TAG's long term management strategies.

Short-term Goals for Upcoming Year

(1) Develop and promulgate a long range strategy for the region.
(2) Raise funding to support critical medical research projects.
(3) Complete a comprehensive husbandry manual.
(4) Identify and promote research designed to provide information and technology supportive of our conservation management strategies.

AAZPA RHINO ADVISORY GROUP

1992 MID-YEAR MEETING

CINCINNATI, OHIO

The mid-year session was called in order to discuss input from the North American Regional TAG to the Global Captive Action Plan Working Group meeting to be held in London in early May. The focus of our discussions was the development of an overall strategy for managing rhinos in North America by examining the resources presently available and comparing that data to what institutions have projected will be available in five to ten years. The second major objective of the meeting was to examine research priorities for rhino and begin to formulate a comprehensive research plan.

MISSION STATEMENT

AAZPA RHINO ADVISORY GROUP

Recognizing that the ultimate objective of captive breeding and related scientific efforts is to preserve wild populations, and that the preservation of wild populations requires the protection and management of habitat and the commitment of people and the governments of the range countries affected, it is the mission of the AAZPA Rhino Advisory Group to:

support and/or initiate basic and applied research which contributes to the management and conservation of rhinos, both in situ and ex situ;

strengthen field conservation efforts by developing and exporting useful management technologies;

develop, maintain and use sustainable captive populations of rhinos to insure that animals will be available to augment existing or reestablish extirpated wild populations as needed;

Promote communication and sharing of information between individuals and organizations working in rhino conservation worldwide; and

encourage our member institutions to support in situ conservation efforts whenever possible.

Space Allocation

The results of a recent space allocation survey indicate that resources for captive rhino programs in North America will continue to grow but that the development of new facilities is somewhat species driven. The data demonstrate that there will be very small increases in the amount of space available for southern white rhino with more institutions interested in adding facilities for black, greater one-horned, and Sumatran rhinos.

Taxon Reports

The following represents the status and objectives of each of the rhino taxa managed within the AAZPA Species Survival Plan program:

Black rhino - At the 1986 African Rhino Workshop it was determined that the eastern and southern populations should be managed as "evolutionarily significant units". The recently published Zimbabwe Rhino Conservation Plan recognizes four subspecies. There currently is a group studying the question of subspeciation in black rhinos and the AAZPA Rhino Advisory Group recommends that the two taxa (michaeli and minor) currently being managed in captivity continue to be managed separately until such time as there is solid concensus to the contrary. Additionally, it was recommended that attempts be made to collect tissue samples from other "subspecies" in order to facilitate a more comprehensive examination of the subspecies issue.

The current North American populations stand at 67 michaeli and 30 minor. Health and reproduction management are the major concerns, although good progress is being made in both areas. The health issues will require new and continued funding in order to find solutions. Target populations of 75 animals each have been set for michaeli and minor.

Southern white rhino - Although many animals were imported into collections in North America in the 1960's and 1970's, reproduction success varied greatly from institution to institution resulting in severe over representation of some founders while others failed to reproduce at all. As a result, much of the emphasis over the past several years has been to equalize founder representation through the transfer and exchange of animals. Additionally, we have also concentrated on reducing the managed population from a high of 182 animals to 126. The target population is 100 animals. Such a reduction allows the population to still be optimally managed while providing additional space for other rhino taxa.

Northern white rhino - Currently, the world captive population consists of only ten animals (four individuals in North America and six in Dvur Kralove). In the wild, 34 individuals are known to exist in Garmaba National Park in Zaire. In recent years, the wild population has shown steady growth, while the captive population

has not. While it would be wise to continue efforts to breed those animals currently in captivity, we are not prepared to advocate a larger role for captive breeding at this time. It is the opinion of the Rhino Advisory Group that all efforts be directed toward:

Conducting reproductive assessments of all individuals currently in captivity

Development of assisted reproduction technology

Increased support of in situ efforts at propagation and protection.

Greater one-horned rhino - The population has grown steadily but slowly and currently contains 40 animals. In order to attain the minimum objectives of the SSP, the program needs to obtain six to eight more founders and increase the population to 84 animals. Nonetheless, the population is being managed very carefully and new institutions are being recruited.

Sumatran rhino - The Rhino Advisory Group makes the following general recommendations:

Encourage those institutions maintaining Sumatran rhinos to insure that all animals of breeding age in the captive population are in situations where males and females are together on a regular (daily) basis for long enough periods of time to increase the probability of pregnancies.

Complete the taxonomic studies of populations in captivity.

Continue the rescue operation aimed at "doomed" animals with those being rescued added to the captive population in order to enhance the opportunities for a successful captive breeding population.

Encourage and support additional studies of the Sumatran rhino in nature and in captivity. There is much to be learned of the behavior, reproductive biology, nutrition and health of this species.

Indonesia and Malaysia should continue to do all that is possible to protect Sumatran rhino populations in these countries. This includes more censusing of the wild population, increased protection from poaching and habitat destruction, and "in situ" captive breeding programs.

Javan rhino - The Rhino Advisory Group makes the following general recommendations:

Continue the censusing program in order to obtain the most accurate population data possible for the Javan rhino in Indonesia and Vietnam.

More field studies on the Javan rhino are badly needed. There is much to be learned regarding the behavior, health, nutrition, reproductive biology and carrying capacity of Ujong Kulon.

Identify those sites on Java where translocation of Javan rhinos might be safely accomplished and determine the carrying capacity of all sites before any rhinos are moved.

When one or more "safe sites" have been identified and the carrying capacity determined, translocate a part of the Ujong Kulon population to a new site.

Continue to protect the Ujong Kulon rhino population in order to prevent any unnecessary losses to these populations due to poaching or any form of harassment or habitat destruction.

Begin "in situ" captive breeding programs for some animals from the wild population as insurance against extinction and to learn more about the behavior and management of the Javan rhino in captivity.

Research

Although attempts have been made to establish a coordinated North American rhino research program, the research efforts on behalf of rhinos have been marked primarily by significant individual efforts. The Rhino Advisory Group has initiated a strategy designed to develop and implement a comprehensive rhino research masterplan. This strategy requires that a multidisciplinary group of scientific advisors be appointed to determine research requirements in the areas of animal health, reproduction, behavior, genetics, and technology and information transfer. Additionally, methods of funding and the need for an overall coordinator will also be determined by the group.

BLACK RHINOCEROS (*Diceros bicornis michaeli* and *Diceros bicornis minor*)

Species Coordinator: Edward J. Maruska, Cincinnati Zoo & Botanical Garden
Subspecies Coordinator: Don Farst, Gladys Porter Zoo
North American Studbook Keeper: Betsy L. Dresser, Center for Reproduction of Endangered Wildlife, Cincinnati Zoo & Botanical Garden
International Studbook Keeper: H.G. Kloss, Berlin Zoo

Introduction

Population genetic analyses has shown that the minimum population size (MVP) for black rhinos in order to maintain 90% of original genetic diversity for 200 years is 150 animal spaces split up into 75 *michaeli* and 75 *minor*. At the present time, there are 68 *michaeli* in 24 institutions and 28 *minor* in 11 institutions for a total of 96 animals in 35 institutions in North America. Even though the goal is to preserve 90% of the average heterozygosity in the gene pool for 200 years, in the case of the black rhino, there seems to be some "intuitive logic" in modifying this objective in terms of rhino generations; ten (10) rhino generations would represent 150-170 years.

At present growth rates *michaeli*, with a population of 68, should be expected to reach the carrying capacity of 75 in about four years. With a current population of *minor* at 28, it will obviously be some time before the SSP population can attain its carrying capacity of 75. The black rhino SSP is in the mature stage.

Data Table: *D.b. michaeli* (current through 1 July, 1992)

	Two Years ago	One Year ago	Current year
Participating Institutions	22	23	24
Captive Population	31.35	31.36	33.35
# SSP animals managed	66	67	68
# SSP animals not required to meet goals	0	0	0
# animals in non-participant collections but desirable to SSP	2	2	2
Total # of births in SSP program	5	1	3
# surviving to one year	4	1	3
# of SSP recommended births	5	1	3
# of non recommended births	0	0	0
# of deaths of SSP animals	2	1	2
# of imports	0	0	0
# of exports	0	0	0
# of founders w/ represented descendents	78	78	78

Data Table: *D.b. minor* (current through 1 July, 1992)

	Two Years ago	One Year ago	Current year
Participating Institutions	7	7	11
Captive Population	7.12	7.12	10.18
# SSP animals managed	19	19	28
# SSP animals not required to meet goals	0	0	0
# animals in non-participant collections but desirable to SSP	0	0	0
Total # of births in SSP program	1	1	1
# surviving to one year	1	0	1
# of SSP recommended births	1	1	1
# of non recommended births	0	0	0
# of deaths of SSP animals	0	1	1
# of imports	0	0	10
# of exports	0	0	0
# of founders w/ represented descendants	11	11	13

Current Population Status

The population of *michaeli* is approaching the proposed MVP of 75 animals since it currently numbers 68 even though the population has only increased by one animal since 1991. The birth rate is minimal at best with only this increase represented by three births and two deaths in 1991. Since the black rhino population in the wild dropped 85% in only 30 years, from 60,000 in 1960 to under 3,000 today, more emphasis needs to be focused on captive breeding in order to increase the birth rate for both *michaeli* and *minor*. All black rhino in the population are SSP non-surplus animals and two *michaeli* in Mexico City have not been included in the North American population because they have not signed the Memorandum of Participation so are not managed as part of the SSP. In 1991, it was deemed that the MVP for *minor* needs to be increased. In regard to this goal, ten *minor* (4.6) were imported on 21 April 1992, seven founders and three calves assumed to be offspring of one of the imported founders. These animals were placed at four new holding institutions: Fossil Rim Wildlife Center, Santillana Ranch, El Coyote Ranch, all in Texas and at White Oak Plantation in Florida. Unfortunately, 1.1 died at Fossil Rim in June 1992. This acquisition was made possible through the International Black Rhino Foundation agreement with the Zimbabwean government. These animals were all wild-caught in Chete Wildlife Reserve.

Demographic Trends

The Black Rhino SSP is attempting to manage two of the four potential evolutionarily significant units (esu's) for black rhino: *michaeli* and *minor*. Reproduction is occurring as explained above, but at a slower rate than is desirable. There have been no recommendations made to remove any animals from the breeding population. The Black Rhino Masterplan has been closely followed and almost every recommendation has been quickly accomplished. A new Masterplan will be completed by 1 September 1992 in order to place unpaired animals in breeding situations and also disperse younger animals to more holding institutions.

Population Genetics

At the present time there are only 13 founders with represented descendents of *minor* in the North American population. There is an ongoing effort to increase founder representation. In Malaysia at Zoo Negara there still is an adult male *michaeli* that is available for import in exchange for a pair of white rhino, but the logistics of exchanging this animal are proving to be difficult. There is a 15 year old female *michaeli* at the Buenos Aires Zoo, Argentina that will be joining the SSP when it arrives in the U.S.

Special Concerns

The population of *minor* continues to be increased and currently there is a dearth of space for *michaeli* which may have an eventual impact on space for *minor*. The Black Rhino SSP has been working with the White Rhino SSP in hopes of moving white rhino from selected institutions to open up more space for black rhino. The Black Rhino SSP may be forced to send some animals out of the U.S. in order to solve this problem. Presently there is a request from the Yokohama Zoo, Japan, for a young male black rhino from the San Diego Zoo. This male will probably be sent there under the prerequisite that the Yokohama Zoo participate in the SSP. The question of whether or not to keep *michaeli* and *minor* as two subspecies still begs an answer and genetic analyses are ongoing even though there are no apparent morphological differences. Also, biochemical analyses to date have not yet demonstrated any differences between *michaeli* and *minor*. There have been several thoughtful letters written by researchers to describe reasons to both merge these populations as well as keep them separate. Work is continuing on this issue. As the wild population continues to decline and space is at a premium, this problem needs to be more quickly resolved.

Research

Current research involves reproduction studies such as hormonal evaluations of urines, bloods, saliva, feces; ultrasound evaluations for pregnancy, ovarian observations and anatomy; semen freezing; anatomical studies at necropsy; development of instrumentation for embryo transfer; nutritional studies involving vitamin E; disease related studies (not much change since 1991). There continues to be a need to increase the focus on nutritional studies and problems involving hemolytic anemia and ulcerative stomatitis that frequently occurs in this species.

Field Conservation

The International Black Rhino Foundation agreement with the Zimbabwean government will help support field operations in Zimbabwe. Funds raised from the efforts of Michael Werhike as he walked across the U.S. will hopefully benefit many AAZPA institutions as well as black rhino in Africa.

Progress Toward Goals

The top five specific goals for the black rhino program that are guiding the program are:

(1) Propagate black rhino in North America to reinforce wild populations in Africa as part of the IUCN global strategy.

(2) Toward this goal, attempt to preserve 90% of the average heterozygosity obtained from wild populations for a period of at least 170 years (ten black rhino generations) and perhaps longer.

(3) Respect, at least initially, the four geographical varieties and potential esu's recognized by the 1986 Cincinnati African Rhino Workshop.

(4) Develop an SSP population of 150 black rhino in North America (carrying capacity).

(5) Expand the captive habitat for black rhino in North America and emphasize reproduction of black rhino in the management recommendations to insure the self-sustainment and expansion of the captive population against the appreciable mortality still occurring.

Progress toward the above stated goals has been described throughout this report.

Short-term Goals for Upcoming Year

These goals are also the Long-Term Target Goals of Black Rhino Working Group (Meeting of this group convened in London on 1 July 1992 as part of the Rhino Global Captive Action Plan)

(1) To increase the recruitment rate and carrying capacity of the captive population through: a) increasing the birth rate; b) enlarging the number of holding facilities; c) increasing the holding space at existing facilities.

(2) Recommendations will be made to wean calves as soon as possible to be able to expose post-lactational cows to bulls.

(3) Management of new *minor* founders will be carefully evaluated to enhance the entire populations.

Five Year Goal

It will be extremely important to evaluate and determine, over the next five years, the nutritional requirements for captive black rhino as well as continue to provide resources to enhance study of reproduction and disease related problems.

WHITE RHINOCEROS (*Ceratotherium simum simum*)

Species Coordinator and Studbook Keeper:
Robert W. Reece, The Wilds

Introduction

Historically, the overall objective of the southern white rhinoceros SSP has been to develop a self-sustaining captive population to reinforce the wild populations in Africa as part of a global strategy. To that end, we have set the goal of preserving 90% of the average heterozygosity obtained from the wild populations for a period of 170-200 years or 10-12 rhinoceros generations. Since there is a continuing need to coordinate the use of the resources available to all of the rhinoceros programs, the southern white rhinoceros population has undergone a gradual reduction over the past several years which would continue until the population was stabilized at approximately 100 animals. In recent months, there has been an active effort to determine the feasibility of further reductions in the North American population, which would provide more resources for the other rhinoceros SSP programs. This further reduction would be appropriate only with the close cooperation of the other regional programs.

Data Table (current through 1 January, 1991

	Two years ago	One year ago	Current year
Participating institutions	41	40	40
Captive population	58.74	58.70	60.70
# SSP animals managed	132	124	126
# SSP animals not required to meet goals	0	4	4
# animal in non participant collections but desireable to SSP	0	0	0
Total births in SSP	2	3	8
# surviving to one year	2	3	6
# of desired births	2	3	8
# of undesired births	0	0	0
# of deaths of SSP animals	3	3	6
# of imports	0	0	0
# of exports	0	0	0
# of founders w/ represented descendents	36	37	38

Current Population Status

The captive white rhinoceros population is being reduced through attrition, export to other regional programs and by the designation of certain animals as research only. Several non-productive animals have been placed in breeding situations and, in some cases, given reproductive examinations to determine their future value to the SSP.

Demographic Trends

Although reproduction had fallen off during the previous two reporting periods, this trend was due primarily to the disruption caused by the translocation efforts. This year reproduction has increased markedly, but it is still too soon to determine the effectiveness of the translocation program.

The population has remained relatively stable but is aging and will require further analysis, based on the results of the efforts to increase the founder population, before we can determine the efficacy of further reducing the population.

Population Genetics

While the current founder base is probably adequate, the fact that the remaining potential founders are approaching 25-30 years of age means that unless the transfers mentioned above provide sufficient stimuli to induce breeding in the very near future there is little likelihood that the founder base will increase perceptibly.

Research

Although research efforts to date have been sporadic and uncoordinated, there is a very real effort to

identify the primary targets for research investigations at the TAG level. It has been proposed both on the regional level and globally that a number of white rhinoceros be specially designated for reproductive and nutritional research projects.

Short-term Goals for the Upcoming Year

1) Complete the space allocation survey and use the results to determine the most effective use of the resources currently allocated to white rhinoceros.
2) Assess the recommendations of the Global Captive Action Plan.
3) Update the white rhinoceros master plan.

GREATER ONE-HORNED RHINOCEROS (*Rhinoceros unicornis*)

Species Coordinator: Michael Dee, Los Angeles Zoo
International Studbook Keeper: Kathleen Tobler, Basel Zoo, Switzerland

Introduction

There are currently 13 institutions participating in the Greater One-horned Asian SSP. However, only eight institutions are breeding this species due to the fact that three have single animals, and two have animals that have not yet reached sexual maturity.

Population genetic analysis has shown that the minimum viable population size (MVP) in order to maintain 90% of original genetic diversity for 200 years is approximately 294 animals, about eight times the current population size in North America. Under these conditions, each participating institution would need to allocate space for 24 animals. Even if the current number of participating institutions was doubled, 12 animals would have to be maintained at each in order to meet the SSP's goals.

At the 1989 Master Plan session, a more realistic approach of maintaining 50 animals was discussed. Ideally, at least 84 animals will need to be maintained through births and importations to meet the minimum objectives of the SSP.

Data Table (current through 1 July, 1992)

	Two Years ago	One Year ago	Current year
Participating Institutions	12	12	13
Captive Population	150	155	120
# SSP animals managed	34	36	41
# SSP animals not required to meet goals	1	0	3
Total # of births in SSP program	22	27	27
# surviving to one year	13	13	18
# of SSP recommended births	3	1	5
# of non recommended births	0	0	0
# of imports	2	0	0
# of exports	1	0	0
# of founders w/ represented descendants	14	14	14

Current Population Status

At present, the SSP population appears to be somewhat secure. Competition with other rhino species has occurred, but does not appear to be serious at this time. At the 1989 Master Plan session, future breeding, surplus and management priorities were discussed. A Master Plan meeting scheduled for 1992 has been rescheduled for 1994.

There are no non-SSP animals in North America. The wild population appears to be somewhat stable, although poaching has occurred in India (present population about 1500) and the Nepal population in Chitwan National Park is expanding by about 10% per year. Forty-three animals have been translocated from Chitwan to the Royal Bardia National Park in the past three years. The species coordinator continues to work with the Nepalese and Indian government to obtain at least six more founder animals for the SSP. The 1990 and 1991 captive population was an estimate as a number of institutions had not reported to the studbook keeper. The 1992 population is an actual count as of 1 July 1992.

Demographic Trends

Life history table analysis of the North American studbook population indicates a growth rate (r) of 1.043, a generation time (T) of 17.5 years, a rate of population increase per generation (R_O) of 2.122, and a life expectancy at birth of twenty years. The Greater One-horned Asian Rhino SSP population has grown at the annual rate of 1.3 animals per year since 1982. All recruitment has been through births and two importations (1987 and 1991). A male born in Washington (the only living descendant of a founder pair) in 1974 sired his first offspring on Christmas Day 1991.

Population Genetics

Inbreeding coefficients (f) for each living animal have been calculated. There are several animals with f=0.25. If the founder population is to effectively meet the SSP's goals, then six to eight new founders need to be brought into the SSP.

Research

Research into rhino reproduction is ongoing at a number of facilities, notably the Cincinnati Zoo, San Diego Zoo and National Zoological Park. Nutritional research is also a priority, particularly as it relates to Vitamin E levels in captive animals. The Metro Toronto Zoo is currently collecting and analyzing urine samples from three institutions.

Short-term Goals for Upcoming Year

(1) Update the Master Plan.
(2) Pair single animals where possible.
(3) Encourage research on rhino nutrition, especially as it related to vitamin E.
(4) Encourage more institutions to become participants in the SSP. At present, four institutions have expressed interest in joining if animals become available.

SUMATRAN RHINOCEROS (*Dicerorhinus sumatrensis*)

Species Co-Coordinators:
James Doherty, New York Zoological Park
James Dolan, San Diego Zoological Society
International Studbook Keeper: Thomas Foose, Ph.D. IUCN, CBSG

Introduction

The Sumatran Rhino SSP and the Sumatran Rhino Trust were brought about to help ensure the survival of this rapidly declining species. In 1985, the Bronx, Cincinnati, San Diego and Los Angeles Zoos established a cooperative agreement with the government of Indonesia. Currently there are four animals (1.3) in North America and an agreement with Indonesia to establish breeding groups, both in the United States and Indonesia.

Data Table (current through 1 July, 1992)

	Two Years ago	One Year ago	Current year
Participating Institutions	4	4	4
Captive Population (Total in world)	19	24	23
# SSP animals managed	0.3	1.3	1.3
# SSP animals not required to meet goals	0	0	0
Total # of births in SSP program	0	0	0
# surviving neonatal period	-	-	-
# of SSP recommended births	-	-	-
# of non recommended births	-	-	-
# of deaths of SSP animals	0	0	2
# of imports	0	1	2
# of exports	-	-	-
# of founders w/ represented descendants	-	-	-

Current Population Status

The SSP population remains low as we continue to assemble the breeding nucleus of ten (5.5) founders. The program was hard hit by the loss of two females in May. The female in the Cincinnati Zoo died after a brief illness despite the heroic efforts of the zoo's staff, advisors and consultants. Later in the month, the female that arrived at the San Diego Zoo last fall died with little warning. These two tragic losses were preceded by the death of the female in Sabah, Malaysia in April. There have not yet been any births to zoo-mated females. This lack of reproduction may be attributable to skewed sex ratios and inability to get breeding age males and females together. The female in the Jakarta Zoo was thought to be pregnant, but this now appears to have been an unsuccessful breeding.

Demographic Trends

In the last 12 months, field capture has progressed. A male and a female were sent to the Taman Safari Park and a female went to the Surabaya Zoo in Indonesia. There are now three (1.2) in the Taman Safari Park and two (1.1) in Surabaya. Two females came to the United States late last year. One of these died in the San Diego Zoo and the other is in the Los Angeles Zoo. A male trapped in March is waiting for export to the United States and the San Diego Zoo.

Population Genetics

The 5.5 founders currently sought for North America are still below an ideal minimum. Eventually, either more founders will be required from the wild or the captive population outside of North America.

Special Concerns

An important consideration in regard to future animal exchanges is the subspecies issue. There are three geographically isolated subspecies from Borneo, Peninsular Malaysia and Sumatra. Genetic studies by the New York Zoological Society are ongoing. DNA sequence data on five rhinos from Sumatra and four from Peninsular Malaysia were compared. Fixed differences were detected making populations diagnosably

distinct. At this time, the data argue for the conservative approach of keeping separate the populations on the Mainland, Sumatra, and Borneo. However, analysis of additional samples (including museum samples) may make it possible to determine whether or not these differences are significant enough to exclude all possibility of inter-populational exchanges in future conservation efforts.

Research

A very successful Indonesian Rhino Workshop was held in Bogor, Indonesia in October 1991, addressing management, research and conservation of the Sumatran rhino and Javan rhinos.

Field Conservation

The Sumatran Rhino Trust survey and salvage operation in Sumatra continues. Poaching is still a serious problem for this species. Wildlife authorities in Malaysia have recently reported the confiscation of horns from eight Sumatran rhinos.

Progress toward Goals

(1) Three rhinos (1.2) were transferred from Sumatra to Java for pairing with animals in collections at the Taman Safari Park and the Surabaya Zoo.
(2) The male rhino captured this year will help breeding potential in the United States once it arrives in the country.

Short-term goals for upcoming year

(1) Facilitate breeding by all existing females in the SSP population.
(2) Complete capture and translocation operation in Sumatra.

EEP Yearbook 1990

with
Summaries of Contributions and Discussions
of the

8th EEP Conference, Budapest

12-15 May 1991

EEP

Published by the EEP Executive office, Amsterdam; October 1991
Compiled and edited by Koen Brouwer, Simone Smits and Leobert de Boer

Black rhinoceros (*Diceros bicornis*) EEP Annual Report 1990

1. Information on organization, structure and activities of the programme

Species coordinator: Prof. Dr. Dr. h.c. H.-G. Klös
Zoologischer Garten und Aquarium Berlin
Hardenbergplatz 8
D-1000 Berlin 30
Germany

Studbook keeper: Prof. Dr. Dr. h.c. H.-G. Klös (International)

Species committee: H.-G Klös, Berlin Zoo
Jiri Vahala, Dvur Kralovè
Christian R. Schmidt, Zürich Zoo

Committee meetings: No meetings were held in 1990

Studbook: The International Studbook for African Rhinoceroses, Volume 4 is in press.

Husbandry guidelines: Not yet available

Research: The Berlin Zoo, in cooperation with the Institute of Biochemistry of the Veterinary Faculty of the University of Vienna, has successfully researched the possibilities to detect pregnancy in black rhino through analysis of hormone levels in faecal matters.

2. Information on status and developments in the programme population in 1990

Status and development of the EEP population: see Table 1

Age and sex distribution of the EEP population: not available

Summary:
Three calves were born in continental Europe in 1990: 0.1 at Berlin Zoo, 0.1 at Dvur Kralovè Zoo and 1.0 at Zürich Zoo. A male calf was also born at Port Lympne, but unfortunately died at approximately six weeks of age.

Two deaths were reported to the coordinator: a ± 36 year old bull at Vienna Zoo and the previously mentioned bull calf at Port Lympne.

The following transfers were made:
0.1 Nr. 35 from Alma Ata to Tallin Zoo

Table 1: Status and development of the Black rhinoceros (*Diceros bicornis*) EEP population in 1990

Participants	Status 1 Jan.	Births (DNS)	Transfers between EEP zoos		Transfers with non-EEP zoos		Deaths	Status 31 Dec.
			in	out	in	out		
Berlin (Zoo)/G	3.5	0.1	-	-	-	-	-	3.6
Dvur Kralovè/CS	4.6	0.1	-	-	-	1.0	-	3.7
Frankfurt/G	2.1	-	-	-	-	-	-	2.1
Leipzig/G	-	-	-	-	-	-	-	-
Magdeburg/G	2.2	-	-	-	-	-	-	2.2
Rome/I	0.1	-	-	-	-	-	-	0.1
Tallin/USSR	1.0	-	-	-	0.1	-	-	1.1
Zürich/CH	1.4	1.0	-	-	-	-	-	2.4
Totals 8 participants	13.19	1.2	-	-	0.1	1.0	-	13.22

1.0 Nr. 164 from London Zoo to Port Lympne
1.0 Nr. 245 from Port Lympne to London Zoo
1.0 Nr. 391 from Dvur Kralovè Zoo to London Zoo
The EEP population of black rhinos consists of 13.20 animals. The total European population is 23.33 individuals.

3. Recommendations for the next year(s)

Hannover Zoo has requested participation in the Black Rhino EEP. Dvur Kralovè Zoo has offered a bull for sale (Suggested price: DM 60.000,=). Rome Zoo is prepared to exchange its single female for a pair of square-lipped rhinos *Ceratotherium s. simum*. Leipzig will receive a pair of black rhinos from Berlin Zoo. Ownership of the Leipzig Zoo bull "Klaus" will then be transferred to Berlin Zoo. This bull was already on breeding loan at Berlin Zoo.
The unification of the two Germanies and the changes in Berlin will result in closer cooperation between the two Berlin zoos. Berlin Zoo plans to send a female on loan to Tierpark Berlin-Friedrichsfelde. The coordinator propose to send the Zürich born male, currently at Frankfurt Zoo to Tierpark Berlin-Friedrichsfelde to join the female.

The good breeding results over the past years have resulted in need to expand the EEP "Carrying Capacity". It is necessary that a number of European zoos that have rhino experience make facilities available for black rhinos.

4. Problems: not specified

Indian rhinoceros (*Rhinoceros unicornis*) EEP Annual Report 1990

1. Information on organization, structure and activities of the programme

Species coordinator: Kathleen Tobler
Zoologischer Garten Basel
4054 Basel
Switzerland

Studbook keeper: Kathleen Tobler (International)

Species committee: Consists of representatives of all participants

Committee meetings: No meetings were held in 1990

Studbook: Last published in 1988. New edition in preparation.

Husbandry guidelines: Not yet available

Research: Not specified

2. Information on status and developments in the programme population in 1990

Status and development of the EEP population: see Table 1

Age and sex distribution of the EEP population: not available

Table 1: Indian rhinos (*Rhinoceros unicornis*) in European collections on 31 December 1990

Antwerp (Planck.)/B	1.2	Hamburg/G	1.1
Basel/CH	2.3	Liberec/CS	1.0
Berlin (Tierpark)/G	2.1	Munich/G	1.1
Berlin (Zoo)/G	1.2	Nuremberg/G	1.0
Chester/GB	1.0	Rotterdam/NL	1.0
Cologne/G	1.1	Stuttgart/G	1.1
Dvur Kralove/CS	2.1	Whipsnade/GB	2.1

3/4. Recommendations/Problems: not yet identified

Table 1: Status and development of the Indian Rhino (Rhinoceros unicornis) EEP population in 1991

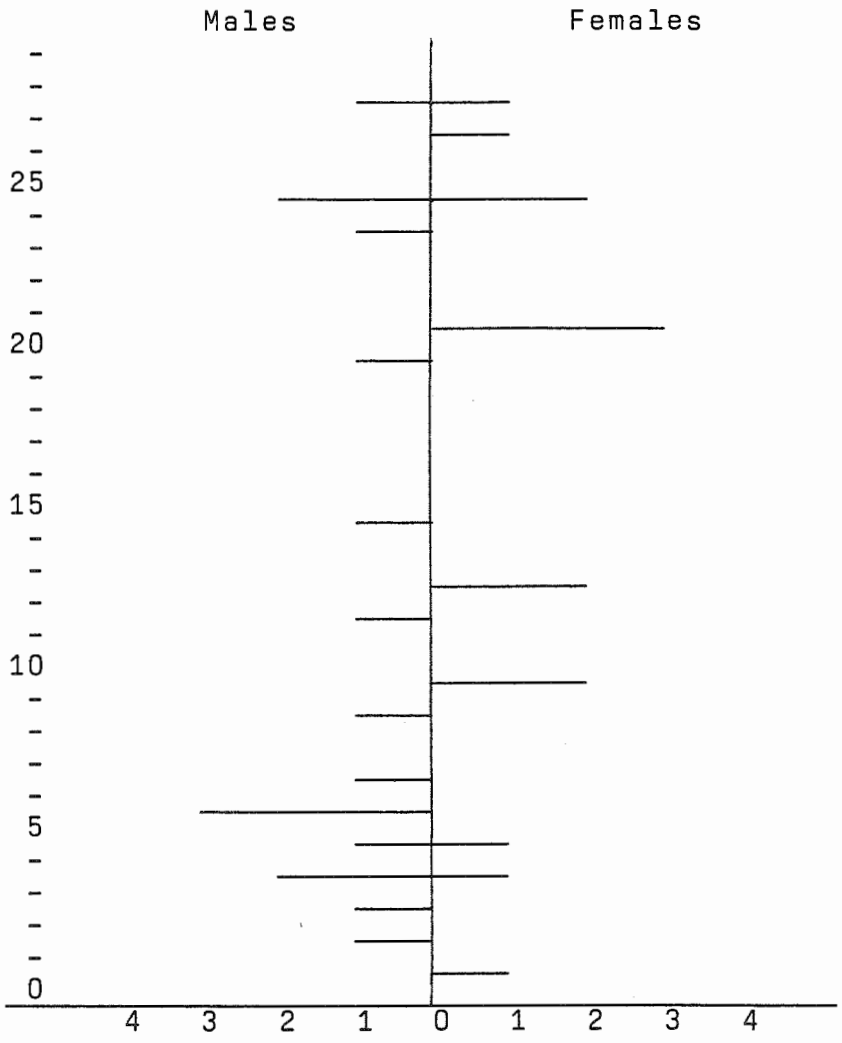
Participants	Status 1.Jan	Births (D NS)	Transfers between EEP Zoos in	Transfers between EEP Zoos out	Transfers with non-EEP Zoos in	Transfers with non-EEP Zoos out	Deaths	Status 31.Dec.
Antwerp/B	1.2							1.2
Basel/CH	2.3					1.1		1.2
Berlin (Tp)/G	2.1							2.1
Berlin (Zoo)/G	1.2							1.2
Chester/GB	1.0							1.0
Cologne/G	1.1							1.1
Dvur Kralove/CS	2.1							2.1
Hamburg/G	1.1							1.1
Liberec/CS	1.0							1.0
Munich/G	1.1							1.1
Numemberg/G	1.0							1.0
Rotterdam/NL	1.0							1.0
Stuttgart/G	1.1	0.1						1.2
Whipsnade/GB	2.1							2.1
Poznan/PL*								
Totals	18.14	0.1				1.1		17.14

15 participants

*rhinos to be held from March 92 (one purchased from Dvkr)

Table 2

Age distribution of the Indian rhino (Rhinoceros unicornis) in Europe as on 31.12.91



RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 11

GLOSSARY OF GLOBAL/REGIONAL PROGRAMS

GLOSSARY OF GLOBAL & REGIONAL CAPTIVE STRATEGIC PROGRAMS

CAMP A Conservation Assessment and Management Plan (CAMP):

(1) reviews the wild and captive status of each taxon in a defined broad group of taxa (e.g. an order, family, subfamily, community);

(2) assesses the degree of threat for each taxon according to the Mace/Lande categories;

(3) recommends intensive management and information collection action to mitigate threat: PHVAs, *in situ* management, conservation oriented research (surveys, taxonomy, etc.) captive breeding, genome banking.

CAMPs are developed as collaborative efforts of the Captive Breeding Specialist Group and the other Specialist Groups of the SSC and ICBP, wildlife agencies, and the Regional Captive Programs.

A CAMP provides:

(1) a resource for the development of IUCN SSC and ICBP Action Plans;

(2) a strategic guide for intensive conservation action;

(3) the first step in the Global Captive Action Plan (GCAP) process.

A CAMP considers multiple taxa.

GCAP A Global Captive Action Plan (GCAP) also considers a broad group of taxa and:

(1) recommends:

(A) which taxa in captivity should remain there;

(B) which taxa in captivity need not be maintained there for conservation reasons;

(C) which taxa not yet in captivity should be there to assist conservation efforts;

(2) proposes a level of captive breeding program in terms of genetic and demographic objectives which translate into recommendations about global captive target populations;

(3) suggests how responsibilities for captive program might be distributed among the Regional Programs, i.e. this function translates into recommendations for regional captive target populations;

(4) identifies priorities for technology transfer to and for financial and other support for *in situ* conservation.

GCAPs are developed by a Working Group which consists of representatives of the Regional Programs, especially the Chairs and selected members of the Taxon Advisory Groups (TAGs), with advice and facilitation from the IUCN SSC Captive Breeding Specialist Group (CBSG). The GCAP Working Group will also normally include representatives of the range-country wildlife community and scientists who can resolve problems of systematics. A CAMP can provide a first step of the GCAP process. The GCAP is developed further in an interactive and iterative process involving the Regional Programs and their own Regional Strategic Collection Plans (RSCPs). The GCAP is a dynamic process and mechanism that enables the Regional Programs to coordinate development of their Regional Strategic Collection Plans (RSCPs) in response to the conservation needs of taxa (as identified initially by the CAMP) but also to the circumstances and interests of the regions. Hence the GCAP is a facilitation and forum for the regional programs to integrate themselves into the best global conservation effort possible.

A GCAP considers multiple taxa.

RSCP A Regional Strategic Collection Plan (RSCP) is a set of recommendations developed by a Regional Taxon Advisory Group (TAG) on the taxa in a defined broad group for which Regional Captive Propagation Programs (RCPP) should be developed. An Regional TAG will consider the recommendations of the CAMP and initial GCAP as one factor in preparing the first drafts of the RSCP. However, the RSCP also considers other factors such as the realities of Regional space and resources in the Region as well as other interests the Region may have in maintaining taxa. As stated above, the GCAPs and RSCPs are interactively and iteratively developed in an effort to maximize effectiveness in using captive space and resources for taxa in need of captive programs for their conservation. An extension of the RSCP for defined broad groups of taxa is an overall strategic collection plan for all organisms to be maintained by institutions participating in the Regional Program. The Australasian Region has already embarged on this kind of overall strategic collection plan.

An RSCP considers multiple taxa.

ICP An Institutional Collection Plan is a strategic design for the taxa that a particular zoo, aquarium, or other captive facility will maintain and propagate. Ideally, an ICP will develop its collection to contribute as much as possible to RSCPs and ultimately GCAPs.

TAG A Taxon Advisory Group is a committee which is formed within the organized Regions of the Zoo/Aquarium World and which consists of zoo professionals and other experts. A primary function of a TAG is to formulate and implement Regional Strategic Collection Plans and by extension development of the GCAP. TAGs also recommend priorities for establishment of studbooks, development of Regional Captive Propagation programs, and research priorities.

A TAG considers multiple taxa.

RCPP A Regional Captive Propagation Program (RCPP) is one of the organized collaborative programs within a Region to breed and manage a designated, usually threatened, taxon. Examples include an AAZPA SSP in North America, an EEP in Europe, a JMSP in the U.K., an ASMP in Australasia, an SSCJ in Japan, an IESBP in India, an APP inn Sub-Saharan Africa. Other Regions are initiating similar programs. RCPPs develop Regional Masterplans for propagation and management of the taxon.

An RCPP normally considers a single taxon (e.g. a species).

GASP A Global Animal Survival Plan (GASP) is a program for management and propagation of a single taxon at the international level. A GASP provides the facilitating framework for the Regional Captive Propagation Programs

(1) to adopt global goals, in part by considering CAMP and GCAP recommendations,
(2) to divide responsibility, e.g. especially target population sizes, for achieving the global goals among the Regional Programs.
(3) to arrange interactions, especially animal or germplasm exchanges, among the Regional Breeding Programs toward achieving global and regional goals.

Analogous to the RCPP, a GASP develops a global masterplan to guide propagation and management of the taxon at the international level.

A GASP normally considers a single taxon.

PHVA A Population and Habitat Viability Analysis (PHVA) is an intensive analysis of a particular taxon or one of its populations. PHVA's use computer models:

(1) to explore extinction processes that operate on small and often fragmented populations of threatened taxa

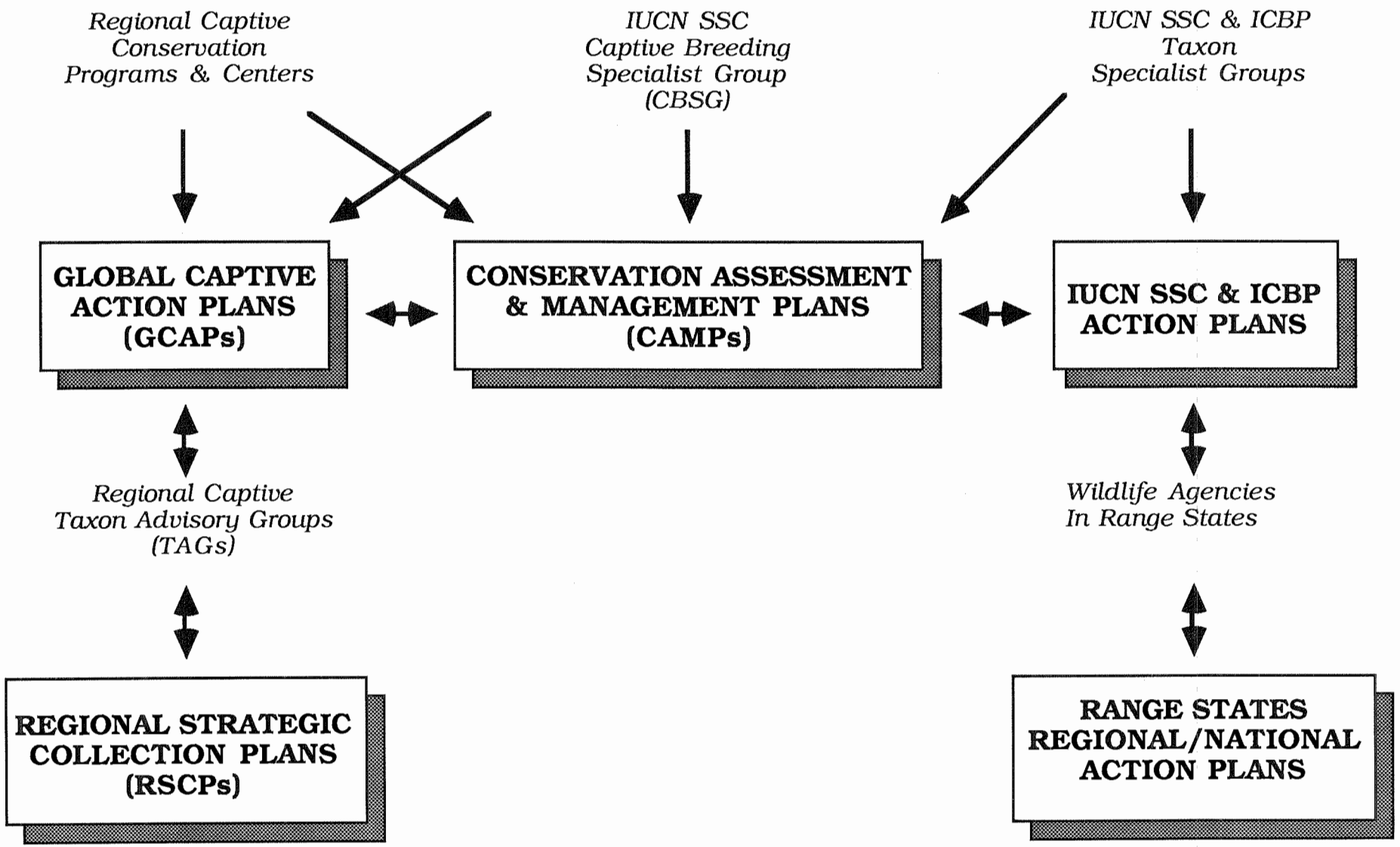
(2) to examine the probable consequences for the viability of the population of various management actions or inactions.

The models incorporate information on distributional, demographic, and genetic characteristics of the population and on conditions in the environment to simulate probable fates (especially probability of extinction and loss of genetic variation) under these circumstances. PHVAs use models to evaluate a range of scenarios for the populations under a variety of management (or non-management) regimes. As a result of the different scenarios modelled, it is possible to recommend management actions that maximize the probability of survival or recovery of the population. The management actions may include: establishment, enlargement, or more management of protected areas; poaching control; reintroduction or translocation; sustainable use programs; education efforts; captive breeding.

A PHVA normally considers <u>one taxon</u> at a time.

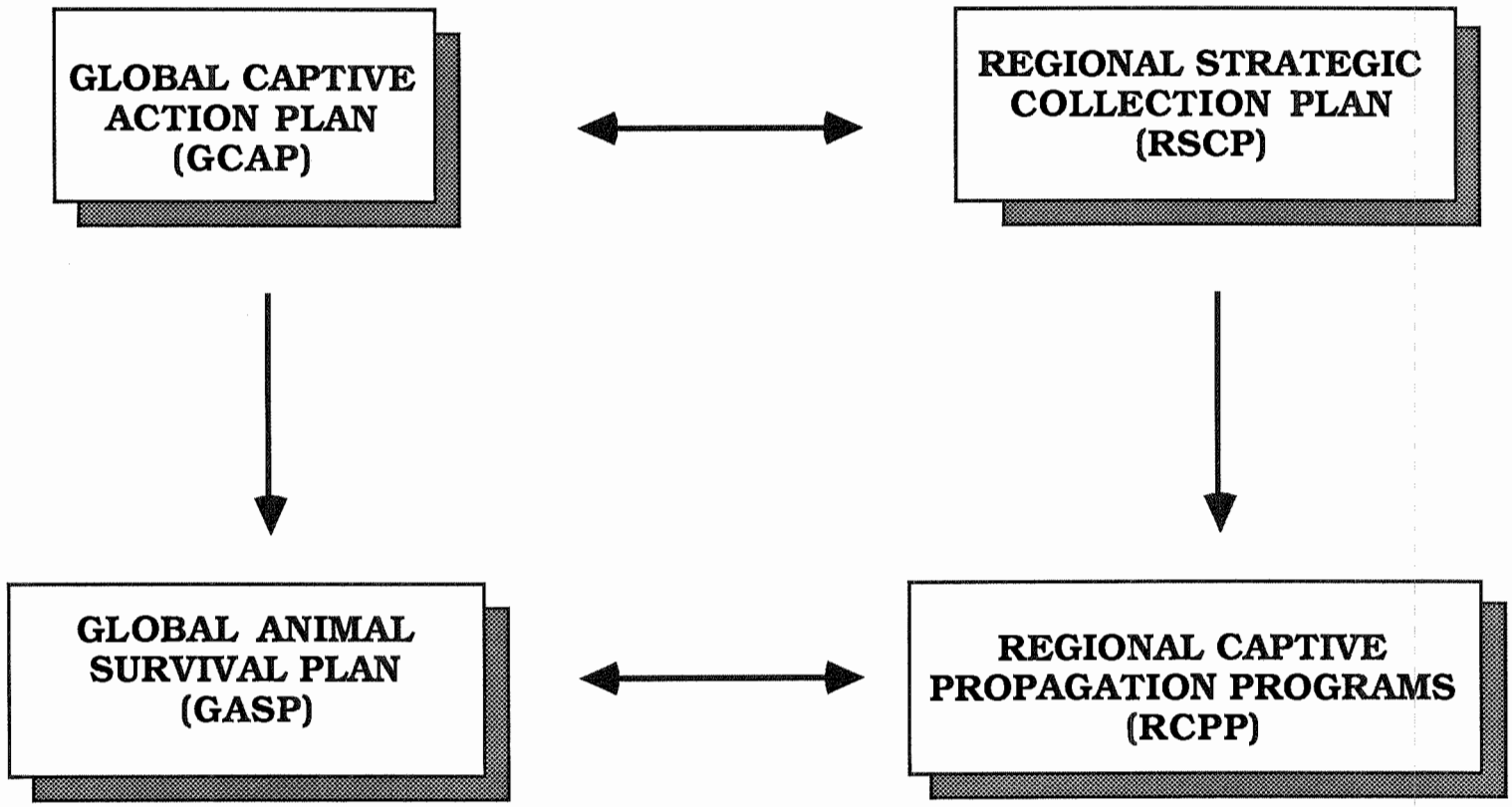
T.J. Foose
CBSG
August 1992

GLOBAL AND REGIONAL STRATEGIC CONSERVATION ACTION PLANS



T.J.F./CBSG
1 August 1992

GLOBAL AND REGIONAL CAPTIVE PROPAGATION PROGRAMS



T.J.F./CBSG
1 August 1992

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 12

GLOSSARY OF POPULATION BIOLOGY TERMS

GENETICS/DEMOGRAPHY GLOSSARY

GENETICS

DNA

Deoxyribonucleic Acid; a chain of molecules contain units known as nucleotides. The material that stores and transmits information inherited from one cell or organisms to the next. The principle DNA is located on the chromosomes in the nucleus of cells. Lesser but still significant DNA is located in the mitochondria.

GENE

The segment of DNA that constitutes a functional unit of inheritance.

LOCUS

The section of the DNA occupied by the gene. Gene and locus (plural: loci) are often used interchangeably.

ALLELE

Alternative forms of a gene. Most strictly, allele refers to different forms of a gene that determine alternative characteristics. However, allele is used more broadly to refer to different copies of a gene, i.e. the 2 copies of each gene that every diploid organism carries for each locus.

ALLELE OR GENE FREQUENCY

The proportion of all copies of a gene in the population that represent a particular allele.

GENOTYPE

The kinds of alleles that an individual carries as its two copies of a gene. As an example, if there are two alleles (A, a) possible at a locus, there are then three genotypes possible: AA, Aa, and aa.

GENOTYPIC FREQUENCY

The proportion of individuals in the population that are of a particular genotype.

HETEROZYGOSITY

The proportion of individuals in the population that are heterozygous (i.e., carry functionally different alleles) at a locus.

HARDY-WEINBERG EQUILIBRIUM

A principle in population genetics that predicts frequencies of genotypes based on the frequencies of the alleles, assuming that the population has been randomly mating for at least one generation. In the simplest case, where there are two alleles (A, a) at a locus and these alleles occur in the frequency p_A and p_a, the Hardy-Weinberg law predicts that after one generation of random mating the frequencies of the genotypes will be: AA = p_A^2; Aa = $2p_Ap_a$; aa = p_a^2.

EXPECTED HETEROZYSITY

The heterozygosity expected in a population <u>if</u> the population were in Hardy-Weinberg equilibrium. Expected heterozygosity is calculated from allele frequencies, and is the heterozygosity expected in progeny produced by random mating. 1 - Σ p_i's, where p_i = the frequency of allele i.

GENE DIVERSITY = EXPECTED HETEROZYSITY

GENOME

The complete set of genes (alleles) carried by an individual.

INBREEDING COEFFICIENT

Probability that the two alleles received at a genetic locus are identical by descent from a common ancestor to both parents. The mean inbreeding coefficient of a population (F) will be the proportional decrease in observed heterozygosity relative to the expected heterozygosity of the founder population.

GENETIC DRIFT

The change in allelic frequencies from one generation to the next due to the randomness (chance) by which alleles are actually transmitted from parents to offspring. This random variation becomes greater as the population, and hence sample of genes, transmitted from one generation to the next, becomes smaller.

BOTTLENECK

A generation in the lineage from a founder when only one or a few offspring are produced so that not all of the founder's alleles may be transmitted onto the next generation.

FOUNDER

An animal from a source (e.g., wild) population that actually produce offspring and has descendants in the living derived (e.g., captive) population.

FOUNDER REPRESENTATION

The percentage or fraction of all the genes in the population at any given time that have derived from a particular founder.

EXISTING REPRESENTATION

The existing percentage representation of founders in the population.

TARGET REPRESENTATION

The desired or target percentage representation of founders. These target figures are proportional to the fraction of each founder genome that survived in the population. Achieving target representation will maximize preservation of genetic diversity.

ORIGINAL FOUNDER ALLELES

The total number of alleles (copies) of each gene carried at each locus by the founders. The number of original founder alleles is twice the number of original founder genomes.

ORIGINAL FOUNDER GENOMES

The set of all genes in a founder. The sum of all such sets are the founder genomes. The number of original founder genomes is half the number of original founder alleles.

FOUNDER ALLELES SURVIVING

The number of alleles still surviving at each locus in the population assuming that each founder carried two distinct alleles at each locus into the derived (captive) population.

ALLELIC RETENTION

The probability that a gene present in a founder individual exists in the living, descendant population.

FOUNDER GENOMES SURVIVING

The number of original founder genomes still surviving in the population. This metric measures loss of original diversity due to bottlenecks in the pedigree of the population. The sum of allelic retentions of the individual founders (i.e, the product of the mean allelic retention and the number of founders).

FOUNDER GENOME EQUIVALENTS (fge)

The number of newly wild caught animals required to obtain the genetic diversity in the present captive population. This metric reflects loss due to both bottlenecks and disparities in founder representation. Equivalently, the number of animals from the source population that contain the same gene diversity as does the descendant population. The proportional gene diversity (relative to original gene diversity) of a population is $H_t/H_0 = 1 - 1 / (2 * fge)$.

EFFECTIVE POPULATION SIZE

A concept developed to reflect the fact that not all individuals in a population will contribute equally or at all to the transmission of genetic material to the next generation. Effective population size is usually denoted by N_e and is defined as the size of an ideal population that would have the same rate of genetic drift and of inbreeding as is observed in the real population under consideration. An ideal population is defined by: sexual reproduction; random mating; equal sex ratio; Poisson distribution of family sizes, i.e. total lifetime production of offspring; stable age distribution and constant size, i.e. demographic stationariness.

COEFFICIENT OF RELATIONSHIP, KINSHIP COEFFICIENT

The coefficient of relationship is the probability that an allele sampled at random from one individual is present in a second individual because of descent of that allele from a common ancestor. Equivalently, it is the proportion of genes in two individuals that are shared because of common descent. A closely related measure is the coefficient of kinship, also called the coefficient of consanguinity. The kinship coefficient is the probability that two alleles drawn at random from two individuals are identical by descent. In the absence of inbreeding, the kinship coefficient is exactly half the coefficient of relationship. The inbreeding coefficient of animal is equal to the kinship between the parents, or 1/2 the coefficient of relationship between the parents.

MEAN KINSHIP (MK)

The mean kinship coefficient between an animal and all animals (including itself) in the living, captive-born population. The mean kinship of a population is equal to the proportional loss of gene diversity of the descendant (captive-born) population relative to the founders and is also the mean inbreeding coefficient of progeny produced by random mating. $H_t/H_0 = 1 - MK = 1 - 1/2fge = 1 - F$. Mean kinship is also the reciprocal of two times the founder genome equivalents. MK = 1/2fge.

KINSHIP VALUE (KV)

The weighted mean kinship of an animal, with the weights being the reproductive values of each of the kin. The mean kinship value of a population predicts the loss of gene diversity expected in the subsequent generation if all animals were to mate randomly and all were to produce the numbers of offspring expected for animals of their age.

DEMOGRAPHY

AGE **AGE CLASS IN YEARS.**

Px **AGE-SPECIFIC SURVIVAL.**

Probability that an animal of age x will survive to next age class.

Lx **AGE-SPECIFIC SURVIVORSHIP.**

Probability of a newborn surviving to a age class x.

Mx **AGE-SPECIFIC FERTILITY.**

Average number of offspring (of the same sex as the parent) produced by an animal in age class x. Can also be interpreted as average percentage of animals that will reproduce.

r **INSTANTANEOUS RATE OF CHANGE.**

If $r < 0$ ..... Population is declining

If $r = 0$ ..... Population is stationary (no change in number)

If $r > 0$ ..... Population is increasing

lambda **RATE OF POPULATION CHANGE PER YEAR.**

If lambda < 1 ..... Population is declining

If lambda $= 1$ ..... Population is stationary

If lambda > 1 ..... Population is increasing

R_o **NET REPRODUCTIVE RATE. RATE OF CHANGE PER GENERATION.**

If $R_o < 1$ ..... Population is declining

If $R_o = 1$ ..... Population is stationary

If $R_o > 1$ ..... Population is increasing

T or G **GENERATION TIME.**

Average length of time between the birth of a parent and the birth of its offspring. Equivalently, the average age at which an animal produces its offspring)

TARGET POPULATION

The ultimate size of the population to be maintained in order to achieve genetic and demographic objectives.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 13

CAMP SPREADSHEET DEFINITIONS

CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP) SPREADSHEET CATEGORIES

(1 August 1992)

The Conservation Assessment and Managment Plan (CAMP) Spreadsheet is a working document that provides information that can then be used to assess degree of threat and recommend conservation action.

The first part of the spreadsheet summarizes information on the status of the wild and captive populations of each taxon. It contains taxonomic, distributional, and demographic information useful in determining which taxa are under greatest threat of extinction. This information can be used to identify priorities for intensive management action for taxa.

TAXON

ID # Simply an a number to facilitate reference to a particular taxon or line in the spreadsheet. A useful convention is to assign sequential integers (1,2,3, ...) to each species and then decimal divisions (1.1, 1.2, 1.3, etc.) to each subspecies within a species.

SCIENTIFIC NAME These 2 columns contain the scientific names of the extant taxa: genus, species, and subspecies.

The next 10 columns contain information on wild populations.

WILD POPULATION:

RANGE: Geographic area where a species and its subspecies occur.

EST #: Estimated Numbers in Wild Population. Best estimate of numbers in wild. Try at least to place all species in one of four categories (that correspond to boundaries of one of the Mace-Lande criteria for assessing category of threat):

< 250
< 2,500
< 10,000
> 10,000

More precise estimates are preferable if possible.

SUB POP: Number (and if possible sizes) of sub-populations of a species. This indicates the degree of fragmentation. Ideally, this is described in terms of boundary conditions as delineated by Mace-Lande (see attached information).

TREND: Indicates whether a species' numbers are increasing (I), decreasing (D), or stable (S). (If possible providing more numeric estimates relative to Mace-Lande)

AREA: A quantification of a species' geographic distribution.

A: < 50,000 sq km
AA < 50,000 sq km but on a geographic island
B: 50-99,000 sq km
C: 100-499,000 sq km
D: 500-999,000 sq km
E: > 1,000,000 sq km

M/L STS: Status according to Mace/Lande criteria (see attached explanation). Can also assign numerical values to facilitate combination with taxonomic uniqueness.

C = Critical
E = Endangered
V = Vulnerable
S = Safe

THRTS: This column contains information about the primary factors behind population decreases. The abbreviations denote the following threats:

D = Disease
H = Hunting for food and/or other purposes
L = Loss of habitat
P = Predation
T = Trade for the live animal market

Some taxa will be subject to more than one of the above threats.

The remaining columns are for recommendations that will be generated at the workshop and for information on current.

PVA/WKSP: Is a Population and Habitat Viability Assessment Workshop recommended. Yes or No

WILD MGMT: Is more intensive *in situ* management indicated. Yes or No.

RSRCH Research

TAX/SRV/ HUSB Is there a need for taxonomic clarification investigations (TX), more survey (quantitative) work (SRV), husbandry research (HB) to permit captive program.

CAPTIVE PROGRAM

NUM: Numbers in Captivity.

CAP REC: Recommendation for level of captive program, defined by its genetic and demographic objectives and hence the target population required to achieve these objectives.

90/100 I: 90% for 100 Years I. Population sufficient to preserve 90% average genetic diversity for 100 years, developed as soon as possible (1-5 years).

90/100 II: Population sufficient to preserve 90% average genetic diversity for 100 years, but developed more gradually (5-10 years).

NUC I: Nucleus I. A captive nucleus (50-100) individuals to always represent 98% of the wild gene pool. This type of program will require periodic, but in most case modest immigration (importation) of individuals from the wild population to maintain this high level of genetic diversity in such a limited captive population.

NUC II: Nucleus II: A captive nucleus (25-100) for taxa not of current conservation concern but present in captivity or otherwise of interest; the captive nucleus should be managed as well as possible.

ELIM: Eliminate from captivity; the captive population should be managed to extinction.

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 14

GCAP WORKSHOP AGENDA AND PROBLEM STATEMENT

Captive Breeding Specialist Group

Species Survival Commission
IUCN -- The World Conservation Union
U. S. Seal, CBSG Chairman

CBSG GLOBAL CAPTIVE ACTION PLAN
RHINOS

LONDON, U.K.
9-10 MAY 1992

DRAFT AGENDA

- Goals & Objectives:
  - Captive Propagation:
    - Taxa Recommended
    - Target Population Objectives
      - Global
      - Regional
  - Research Priorities
  - In Situ Support:
    - Prioritization of Needs
    - Coordination of Efforts
- Global SSP's
  - Status of Regional Programs
  - Development of Global Masterplans
  - Formation of Management Committees & Selection of Global Coordinators.
- Studbook Matters
- Subspecies Issues
- Husbandry/Health Problems
  - Black Rhino
  - Other Taxa
- Reintroductions

12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, USA tel. 612-431-9325 fax 612-432-2757
(home) 9801 Pillsbury Ave. S., Bloomington, MN 55420, USA tel. 612-888-7267 fax 612-888-5550

RHINO GLOBAL CAPTIVE ACTION PLAN WORKSHOP

T.J. Foose, Ph.D. - CBSG Executive Officer

A Global Captive Action Plan Workshop for Rhino will occur at the London Zoo 9-10 May 1992 immediately after the Sixth World Conference on Breeding Endangered Species on the Isle of Jersey.

The purpose of this Workshop is to provide strategic guidance for intensive management techniques to threatened taxa in these groups. As populations of many of these taxa are reduced and fragmented in the wild, more intensive management becomes necessary for their survival and recovery. This intensive management may include, but is not limited to, captive breeding.

Therefore, the Workshop will formulate recommendations about which taxa are in need of various kinds of intensive management attention both *ex situ* and *in situ* with which the captive community can realistically assist. The kinds of attention include:

(A) Population and Habitat Viability Assessment and Conservation Management Plan (PHVA/CMP) Workshops.
(B) Intensive (captive-type) protection and management in the wild.
(C) *In situ* and *ex situ* research where the captive community can reasonably assist: e.g., taxonomic clarification, some survey support.
(D) Captive propagation programs that sooner or later hopefully can be linked to interactions with wild populations.
(E) Experimental re-introduction projects.

In terms of captive propagation, this Global Action Plan Workshop would include consideration of how the various Regional programs for rhino would interact and combine to form truly global efforts. An important aspect would be establishment of target population size goals (i.e. how many rhino to ultimately try to maintain) on a global basis and in each of the regions. These target population goals will be largely determined by demographic and genetic goals adopted for the program. The Workshop will also attempt to recommend responsibilities for captive programs might best be distributed among organized Regions of the global captive community. Finally, there will be an attempt to initiate integration of the Regional Propagation Programs into Global Programs.

While the emphasis in Global Captive Action Plans is on *ex situ* activities, the Workshop will also consider how to more strategically develop and coordinate *in situ* conservation activities by zoos, especially financial support for field efforts. In particular, there will be an attempt (1) to identify where and how the captive community can assist with transfer of intensive management information and technology (2) to develop priorities for the limited financial support the captive community can provide for *in situ* conservation (e.g., adopt-a-protected-area program).

Participants for this Workshop are all International and Regional Studbook Keepers and Species Coordinators for each of the rhino taxa, African and Asian. It is also considered important that representatives of the management authorities in major countries of origin of the various rhino be involved if possible. A number of field conservationists will be at the Jersey Conference and hopefully can attend the Global Captive Action Plan Workshop.

Captive Breeding Specialist Group

Species Survival Commission
IUCN -- The World Conservation Union

U. S. Seal, CBSG Chairman

30 January 1992

TO: Attached List of Rhino Conservationists:
- International & Regional Studbook Keepers
- Coordinators Regional Rhino Captive Breeding Programs
- Regional Rhino Taxon Advisory Group Chairs
- Conservation Coordinators Regional Zoo Programs
- Chairs & Selected Members SSC Rhino Specialist Groups
- Other Selected Rhino Experts

FROM: Tom Foose, CBSG Executive Officer

SUBJECT: **RHINO GLOBAL CAPTIVE ACTION PLAN WORKSHOP**

You are cordially invited to attend a Global Captive Action Plan Workshop for rhinos at the London Zoo 9-10 May 1992 immediately after the Sixth World Conference on Breeding Endangered Species on the Isle of Jersey which many of you will be attending. Such a workshop has been contemplated by the CBSG Rhino Working Group for some time and has beenn specifically recommended by them to occur at this time.

A draft agenda for this Workshop is attached.

The purpose of this Workshop is to provide strategic guidance for intensive management techniques to threatened taxa in these groups. As populations of many of these taxa are reduced and fragmented in the wild, more intensive management becomes necessary for their survival and recovery. This intensive management may include, but is not limited to, captive breeding.

Therefore, the Workshop will formulate recommendations about which taxa are in need of various kinds of intensive management attention both *ex situ* and *in situ* with which the captive community can realistically assist. The kinds of attention include:

(A) Population and Habitat Viability Assessment and Conservation Management Plan (PHVA/CMP) Workshops.
(B) Intensive (captive-type) protection and management in the wild.
(C) *In situ* and *ex situ* research where the captive community can reasonably assist: e.g., taxonomic clarification, some survey support.
(D) Captive propagation programs that sooner or later hopefully can be linked to interactions with wild populations.
(E) Experimental re-introduction projects.

12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, USA tel. 612-431-9325 fax 612-432-2757
(home) 9801 Pillsbury Ave. S., Bloomington, MN 55420, USA tel. 612-888-7267 fax 612-888-5550

In terms of captive propagation, this Global Action Plan Workshop would include consideration of how the various Regional programs for rhino would interact and combine to form truly global efforts. An important aspect would be establishment of target population size goals (i.e. how many rhino to ultimately try to maintain) on a global basis and in each of the regions. These target population goals will be largely determined by demographic and genetic goals adopted for the program. The Workshop will also attempt to recommend responsibilities for captive programmes might best be distributed among organized Regions of the global captive community. Finally, there will be an attempt to initiate integration of the Regional Programs into a Global one.

While the emphasis in Global Captive Action Plans is on *ex situ* activities, the Workshop will also consider how to more strategically develop and coordinate *in situ* conservation activities by zoos, especially financial support for field efforts. In particular, there will be an attempt (1) to identify where and how the captive community can assist with transfer of intensive management information and technology (2) to develop priorities for the limited financial support the captive community can provide for *in situ* conservation (e.g., adopt-a-sanctuary programmes).

Proposed participants for this workshop are all International and Regional Studbook Keepers and Species Coordinators for each of the rhino taxa, African and Asian. It is also considered important that representatives of the management authorities in major countries of origin of the various rhino be involved if possible. A number of field conservationists will be at the Jersey Conference and hopefully can attend the Global Captive Action Plan Workshop.

Attached is a draft agenda for this Workshop. Also attached are two preliminary tables to guide further thought toward these objective.

Table 1 The numbers on current sizes of the captive populations in each identified Region has been derived by data in the International Studbooks, the information provided at the 1990 San Diego Rhino Conference, and refined by some direct communication with Regional Coordinators. What is not included in this table are any estimates of the projected (future) space that may be available for each taxon of rhino.

Table 2 The data on the number of critical sanctuaries for each taxon of rhino has been concluded from the SSC Action Plans for African and Asian Rhinos. The data on the support being provided by the captive community for in situ rhino conservation is my own crude compilation and will need to be improved at the Workshop.

All participants are requested to provide any updates to these tables to me before, or carry their additional data, to the Workshop.

The Workshop will be conducted in the Meeting Rooms at the Zoological Society of London, Regent's Park. Lunches and refreshment breaks will be provided. Alexandra Dixon has graciously agreed to coordinate the local logistics for the meeting and will be able to arrange accommodations for you in the vicinity upon request. To help defray costs incurred by the host, a registration fee of £25 is being requested. Attached is a form to facilitate your response.

Thanks very much. Please don't hesitate to contact me for any further information.

cc: L. Calvo, R. Khan, C. Padua, W. Conway, G. Rabb, S. Stuart

INVITED PARTICIPANTS - RHINO GLOBAL CAPTIVE ACTION PLAN WORKSHOP

Rashid Aman	Rhino Geneticist
George Amato	Rhino Geneticist
B.M. Arora	Conservation Coordinator Indian Zoos
General Ashari	Conservation Coordinator S.E.Asia Zoo Association
Rob Brett	Kenya Wildlife Service Rhino Coordinator
Martin Brooks	Chairman IUCN SSC African Rhino Specialist Group
Koen Brouwer	EEP Executive Office
Tom Foose	International Studbook Sumatran Rhino/CBSG
Mike Dee	Coordinator Indian/Nepali Rhino SSP (N. America)
Alexandra Dixon	Conservation Officer London Zoological Society
Jim Doherty	Co-Coordinator Sumatran Rhino SSP (N. America)
Jim Dolan	Co-Coordinator Sumatran Rhino SSP (N. America)
Ellen Dierenfeld	Rhino Nutritionist
Betsy Dresser	Rhino Reproductive Specialist
Don Farst	Sub-Coordinator Southern Black Rhino SSP
Richard Faust	Director Frankfurt Zoological Society
Reinhardt Frese	International Studbook Keeper African Rhinos
Chris Furley	Howlett's-Port Lympne Sumatran Rhino Programme
Paul Garland	Chair ASMP Rhino TAG/Coordinator White Rhino ASMP
Anthony Hall-Martin	Elephant & Rhino Foundation (S. Africa)
Keith Hodges	Rhino Reproductive Biologist
Michael Hutchins	AAZPA Director Conservation & Science
Jim Jackson	President, International Black Rhino Foundation
David Jones	Rhino Coordinator JMSG (U.K.)
John Kelly	ASMP Coordinator Black Rhino (Australasia)
Mohd Khan	Chairman IUCN SSC Asian Rhino Specialist Group
Larry Killmar	SSP Subspecies Coordinator, Northern White Rhino
Heinz-Georg Klös	African Rhino Species Coordinator EEP (Europe)
John Knowles	Deputy Chair of CBSG
Michael Kock	Zimbabwe Rhino Program
Richard Kock	Rhino Specialist Z.S.L. & Kenya Wildlife Service
Atsushi Komori	Conservation Coordinator SSCJ (Japan)
Jansen Manansang	Taman Safari Indonesia
Andrew Laurie	Member African & Asian Rhino Specialist Group
Nigel Leader-Williams	Member African Rhino Specialist Group
Nick Lindsay	JMSC TAG Coordinator, Black & White Rhino
Sukianto Lusli	Indonesian Rhino Foundation
Georgina Mace	Rhino Population Biologist
Mitsuko Masui	Rhino Coordinator SSCJ (Japan)
Ed Maruska	Coordinator Black Rhino SSP (N. America)
Daryl Miller	Australasian ASMP Coordinator for Asian Rhinos
Eric Miller	Rhino Health Specialist
William Nduku	Zimbabwe Rhino Program
Barbara Porter	Conservation Coordinator ASMP (Australasia)
Linda Prasetyo	Indonesia PHPA Rhino Specialist
Mark S. Price	Chair IUCN SSC Reintroduction Specialist Group
Robert Reece	Chair AAZPA Rhino TAG/Coordinator White Rhino SSP
Randy Rockwell	Prospective Coordinator White Rhino SSP
Alex Rubel	Director Zoo Zurich
Dieter Ruedi	Coordinator Indian/Nepali Rhino EEP (Europe)
Ollie Ryder	Rhino Geneticist
Christian Schmidt	Asst. Director Zoo Zurich
Kes H. Smith	Garamba White Rhino Specialist
Peter Spala	Dvur Kralove Rhino Coordinator
Miranda Stevenson	Chair, Joint Management of Species Committee (JMSC) U.K.
Mohd Tajuddin	Sumatran Rhino Studbook Keeper
Ron Tilson	CBSG "Adopt-A-Park" Catalyst/Coordinator
Kathleen Tobler	International Studbook Keeper Indian Rhino
Kristina Tomasova	Dvur Kralove Rhino Coordinator
Nico Van Strien	Member Asian Rhino Specialist Group

INVITED PARTICIPANTS - RHINO GLOBAL CAPTIVE ACTION PLAN WORKSHOP
(Continued)

Tim Sullivan	IUCN Species Survival Commission (SSC)
Sally Walker	Zoo Outreach Organization India
Karen Wachs	Co-Editor AROUND THE HORN
Vivian Wilson	Species Coordinator for African APP (Sub-Saharan Africa)
Stefano Zago	Sabah Rhino Program

RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

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SECTION 15

GCAP WORKSHOP PARTICIPANTS

RHINO GCAP WORKSHOP PARTICIPANT LIST

George Amato
New York Zoological Park
185th Street & Southern Boulevard
Bronx, NY 10460
USA
Phone: 212-220-5100
Fax: 212-220-7114

Derrick Brett
Sumatran Rhino Survey
33 Beauchamp Road
London SW11 1PG
UNITED KINGDOM
Phone: 44-71-585-2004
Fax: 44-71-498-1503

P. Martin Brooks,
Chairman IUCN/SSC African Rhino Specialist Group
Natal Parks Board
PO Box 662
Pietermaritzburg 3200
SOUTH AFRICA
Phone: 27-331-471961
Fax: 27-331-471037

Koen Brouwer
EEP Executive Office
National Foundation for Research in Zoos
Postbus 20164
1000 HD Amsterdam
THE NETHERLANDS
Phone: 31-20-6207476
Fax: 31-20-6253931

Nancy Czekala
San Diego Zoo
PO Box 551
San Diego, CA 92112
USA
Phone: 619-557-3942
Fax: 619-557-3959

Michael Dee
SSP Indian/Nepali Rhino Coordinator
Los Angeles Zoo
5333 Zoo Drive
Los Angeles, CA 90027
USA
Phone: 213-666-4650
Fax: 213-662-9786

Alexandra Dixon
Zoological Society of London
Regent's Park
London NW1 4RY
UNITED KINGDOM
Phone: 44-71-722-3333
Fax: 44-71-483-4436

Betsy Dresser
North American Regional Studbook Keeper Black Rhino
Cincinnati Zoo & Bot. Gardens
3400 Vine Street
Cincinnati, OH 45520
USA
Phone: 513-961-2739
Fax: 513-569-8213

Thomas J. Foose
CBSG
12101 Johnny Cake Ridge Road
Apple Valley, MN 55124
USA
Phone: 612-431-9255
Fax: 612-432-2757

Neil Franklin
Sumatran Rhino Survey
33 Beauchamp Road
London SW11 1PG
UNITED KINGDOM
Phone: 44-71-585-2004
Fax: 44-71-498-1503

Reinhard Frese
EEP Black Rhino Coordinator
Int'l Studbook Keeper - African Rhino
Zoologischer Garten & Aquarium Berlin
Hardenburgplatz 8
W-1000 Berlin 30
GERMANY
Phone: 49-30-261-1101
Fax: 49-30-254-01255

Paul Garland
ASMP White Rhino Coordinator
Orana Park Wildlife Trust
MacLeans Island Road
PO Box 5130, Papanui
Christchurch
NEW ZEALAND
Phone: 64-3-359-7109
Fax: 64-3-359-4330

Charles Hoessle
St. Louis Zoological Park
Forest Park
St. Louis, MO 63110
USA
Phone: 314-781-0900
Fax: 314-647-7969

Mike Hutchins
AAZPA Director of Conservation & Science
AAZPA Conservation Center
7970 Old Georgetown Road
Bethesda, MD 20814
USA
Phone: 301-907-7777
Fax: 301-907-2980

Jim Jackson
President Int'l Black Rhino Foundation
Fossil Rim Wildlife Center
PO Box 2189
Glen Rose, TX 76043
USA
Phone: 817-897-2960
Fax: 817-897-3785

Susie Jackson
London Zoological Society
Regent's Park
London NW1 4RY
UNITED KINGDOM
Phone: 44-71-722-3333
Fax: 44-71-483-4436

Mohd Khan
Chairman IUCN/SSC Asian Rhino Specialist Group
Dept. of Wildlife & National Parks
KM 10, Jalan Cheras
56100 Kuala Lumpur
MALAYSIA
Phone: 60-3-905-2872
Fax: 60-3-905-2873

Mike Kock
National Parks & Wildlife Mngmt
PO Box 8365, Causeway
Harare
ZIMBABWE
Phone: 263-4-707624
Fax: 263-4-724914

Andrew Laurie
Tanzania Rhino Project
c/o SPDT
PO Box 2032
Dar es Salaam
TANZANIA
Phone: 44-223-315325
Fax: 44-223-352618

Nick Lindsay
General Curator
Zoological Society of London
Whipsnade Park
Whipsnade, Dunstable
Beds LU6 2LF
UNITED KINGDOM
Phone: 582-872171
Fax: 582-872649

Georgina Mace
Zoological Society of London
Institute of Zoology
Regent's Park
London NW1 4RY
UNITED KINGDOM
Phone: 44-71-586-3011
Fax: 44-71-483-2237

Jansen Manansang
Taman Safari Indonesia
Jl. Sekolah Duta V/II
Pondok Indah
Jakarta 12310
INDONESIA
Phone: 62-251-4422
Fax: 62-251-328225

Ed Maruska
SSP Black Rhino Coordinator
Cincinnati Zoo
3400 Vine Street
Cincinnati, OH 45220
USA
Phone: 513-559-7749
Fax: 513-559-7791

Mitsuko Masui
Chair SSCJ Rhino TAG
Tama Zoological Park
7-1-1 Hodokubo
Hino-shi,
Tokyo 191
JAPAN
Phone: 81-425-91-1611
Fax: 81-425-93-4351

George Rabb
Chairman IUCN Species Survival Commission
Chicago Zoological Park
3300 Golf Road
Brookfield, IL 60513
USA
Phone: 708-485-0263
Fax: 708-485-3532

Bruce Read
Chairman AAZPA Wildlife Conservation & Management Committee
St. Louis Zoological Park
Forest Park
St. Louis, MO 63110
USA
Phone: 314-781-0900
Fax: 314-647-7969

Robert Reece
Chair AAZPA Rhino TAG
The Wilds
85 East Gay Street
Suite 603
Columbus, OH 43215
USA
Phone: 614-228-0402
Fax: 614-228-7210

Oliver Ryder
Center, Rep. of End. Species
Zoological Society of San Diego
PO Box 551
San Diego, CA 92112
USA
Phone: 619-557-3950
Fax: 619-557-3959

Christian Schmidt
Zoologischer Garten Zurich
Zurichstrasse 221
CH-8044 Zurich
SWITZERLAND
Phone: 411-251-5411
Fax: 411-261-3124

Ulysses Seal
Chairman
CBSG
12101 Johnny Cake Ridge Road
Apple Valley, MN 55124
USA
Phone: 612-431-9325
Fax: 612-432-2757

Petr. Spala
Center, Rep. of End. Species
Zoological Society of San Diego
PO Box 551
San Diego, CA 92112
USA
Phone: 619-557-3950
Fax: 619-557-3959

Ron Tilson
Minnesota Zoological Gardens
13000 Zoo Boulevard
Apple Valley, MN 55124
USA
Phone: 612-431-9267
Fax: 612-432-2757

Kathleen Tobler
EEP Indian/Nepali Rhino Coordinator
Zoologischer Garten Basel
CH-4054 Basel
SWITZERLAND
Phone: 41-61-54-0000
Fax: 41-61-281-0005

Kristina Tomasova
Zoologicka Zahrada ve Dvore
Kralove n.L.
544 01
Dvur Kralove Nad Labem
CZECHOSLOVAKIA
Phone: 42-437-3751
Fax: 42-437-3925

Nico J. van Strien
IUCN/SSC Asian Rhino Specialist Group
Julianaweg 2
3941 DM Doorn
THE NETHERLANDS
Phone: 31-3430-13642
Fax:

W. Verberkmoes
Safari Beekse Bergen
Beekse Bergen 1
5081 NJ Hilvarenbeek
THE NETHERLANDS
Phone: 31-13-36-0032
Fax: 31-13-35-7966

Simon Wakefield
Marwell Zoological Park
Colden Common
Winchester
Hants SO21 1JH
UNITED KINGDOM
Phone: 44-962-777407
Fax: 44-962-777511

Sally Walker
Zoo Outreach Organisation
CBSG/INDIA
PO Box 1683
Peelamedu, Coimbatore
Tamil Nadu 641 004
INDIA
Phone: 91-422-571087
Fax: 91-422-210028

Philip Wells
Sumatran Rhino Survey
33 Beauchamp Road
London SW11 1PG
UNITED KINGDOM
Phone: 44-71-585-2004
Fax: 44-71-498-1503

Viv Wilson
APP Conservation Coordinator
Chipangali Wildlife Trust
PO Box 1057
Bulawayo
ZIMBABWE
Phone: 263-9-70764
Fax: 263-9-72187