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

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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	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

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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	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

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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	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

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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	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

Model Parameters

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

**** = Not Possible with these parameters

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.

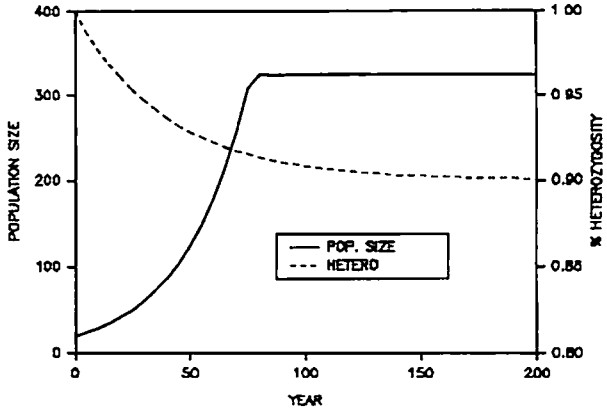

Figure 1: This population needs to grow to about 325 animals to maintain 90% of its original heterozygosity.

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

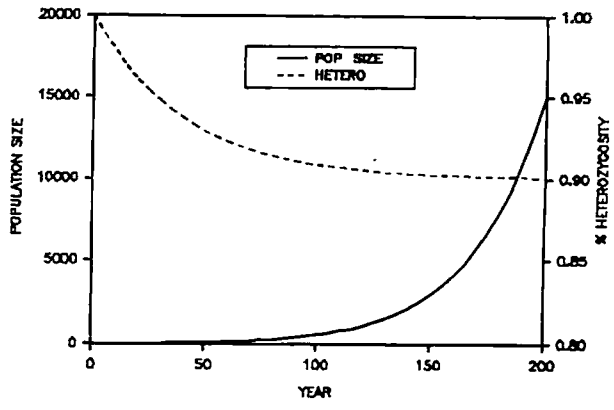

Figure 2: Population size required to maintain 90% of the original heterozygosity exceeds realistic numbers.

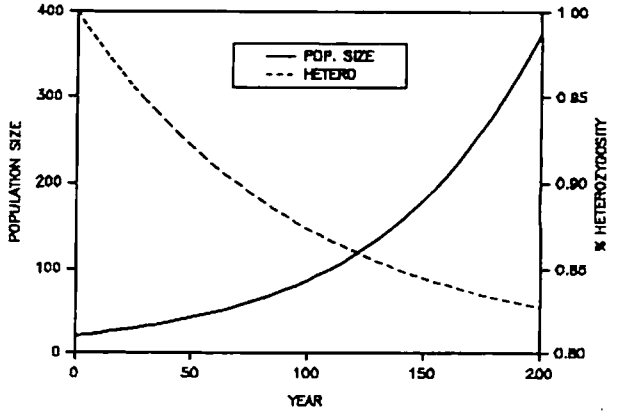

Figure 3: Heterozygosity drops below target (90%) before program ends, despite maximum growth of the population.

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.

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        Model Parameters
                        ------------------------------
Population's Effective  30 | 160   263   370   623   850 |  Lambda:       1.250
          Size          40 | 150   247   347   573   780 |  Gen. Length:    6.0
                        50 | 147   240   333   550   743 |  Ne/N Ratio:   0.30
                        60 | 147   233   327   537   720 |  Het. to Date: 97.5
                        70 | 147   230   320   527   710 |  Years Elapsed:    7
                        ------------------------------

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RHINO

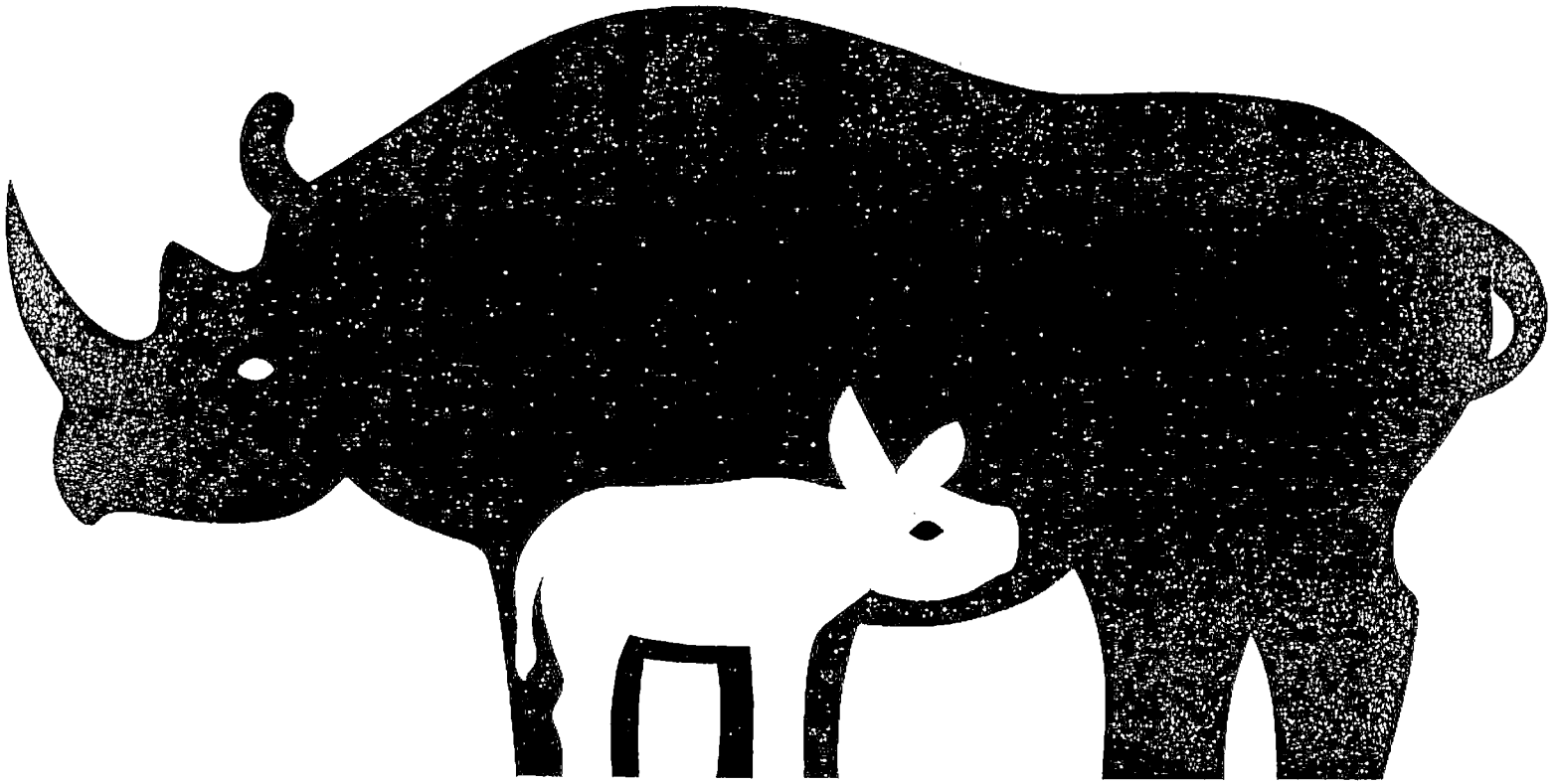
GLOBAL CAPTIVE ACTION PLAN (GCAP)

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

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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

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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_0) 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 Kralovê/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 Kralovê 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 Kralovê 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

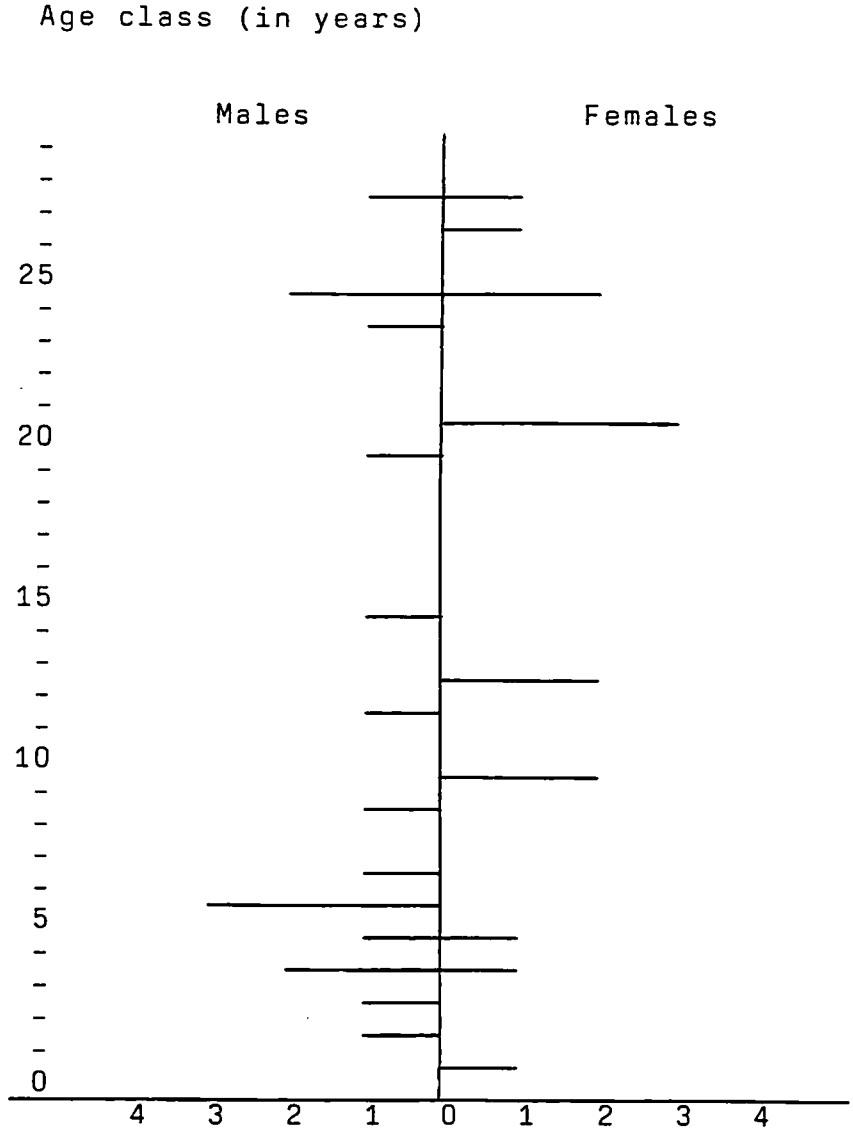
Participants	Status 1.Jan	Births (DNS)	Transfers between EEP Zoos in	Transfers between EEP Zoos out	Transfers with non-EEP Zoos in	Transfers with non-EEP Zoos out	Deaths	Status 31.Dec.
Antwerp/B	1.2							1.2
Basel/CH	2.3					1.1		1.2
Berlin (Tp)/G	2.1							2.1
Berlin (Zoo)/G	1.2							1.2
Chester/GB	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

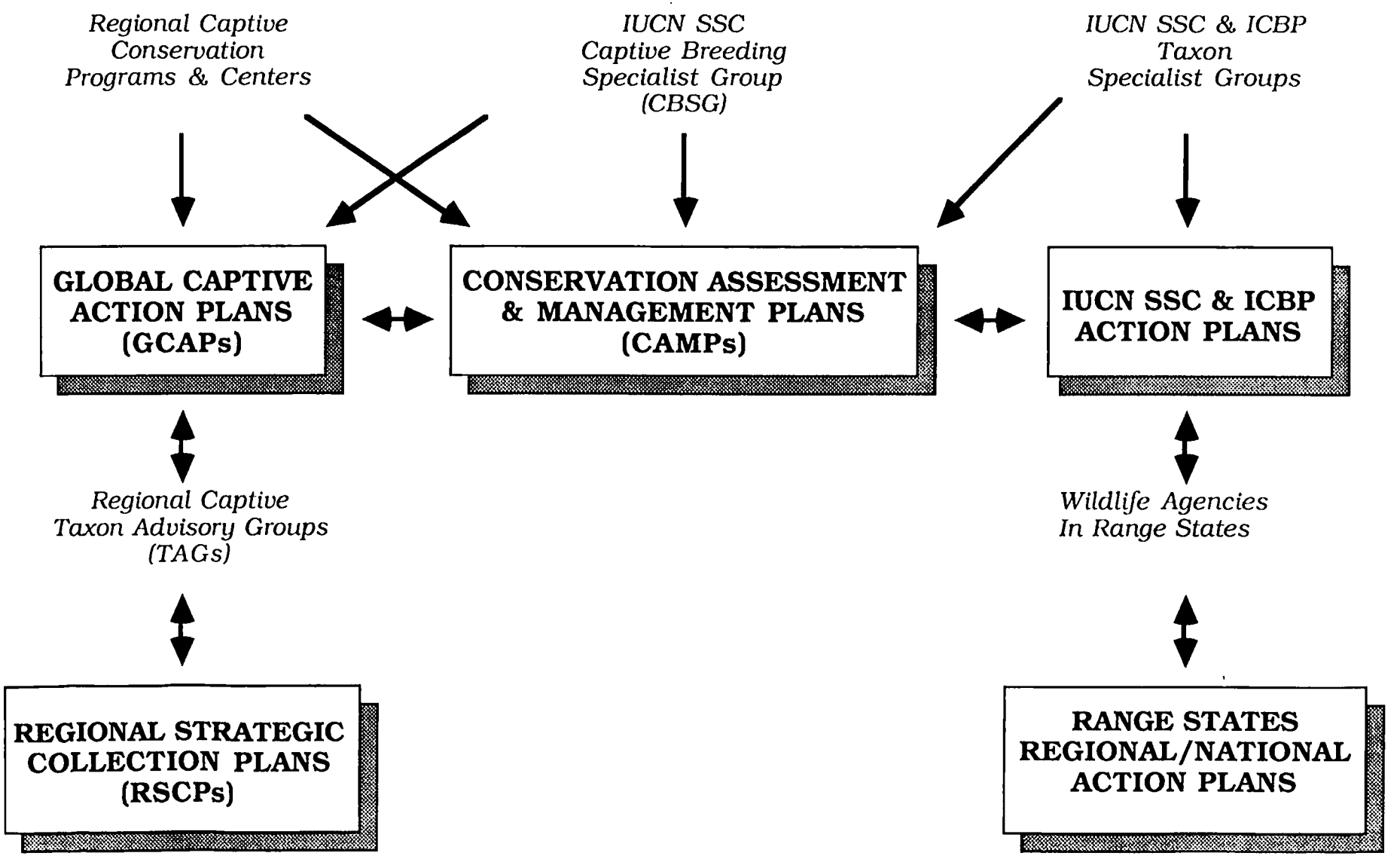
(2) to examine the probable consequences for the viability of the population of various management actions or inactions.

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.

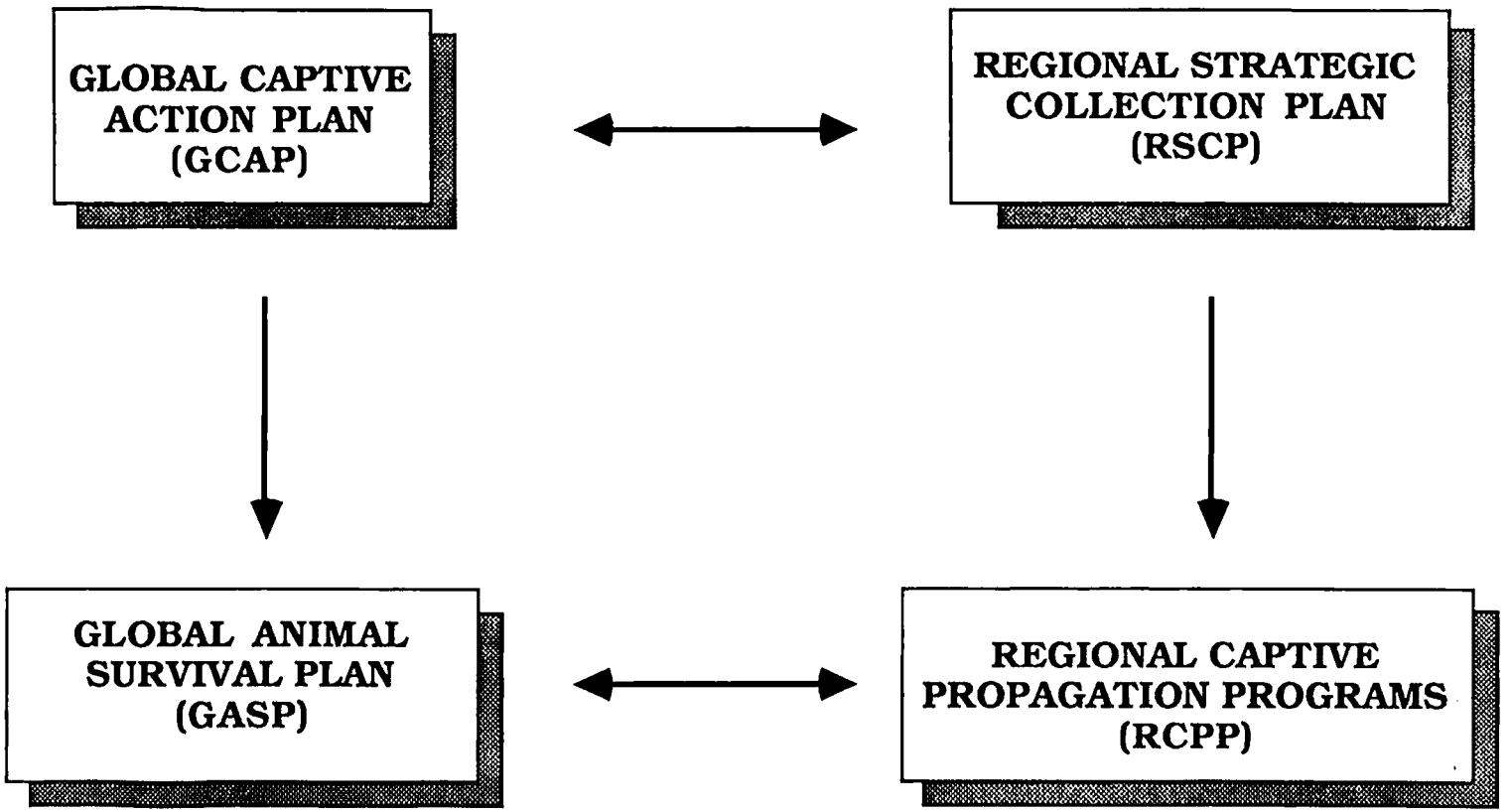
T.J. Foose
CBSG
August 1992

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. $1 - \Sigma\ p_i$'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.

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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

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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:

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(E) Experimental re-introduction projects.

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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

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RHINO

GLOBAL CAPTIVE ACTION PLAN (GCAP)

FIRST EDITION

1 SEPTEMBER 1992

SECTION 15

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