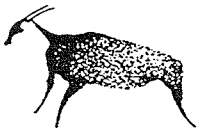
WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Bruce Read, Danny Morris, Chuck Brady, Pat Thomas, Steve Shurter,
Marilyn Anderson, Naida Loskutoff, Larry Killmar, Jim Dolan, Lee Simmons,
David Wildt, and Onnie Byers



SPECIES SURVIVAL COMMISSION

A Collaborative Workshop

SSC Wild Cattle Specialist Group

AZA Wild Cattle Taxon Advisory Group

IUCN/SSC Conservation Breeding Specialist Group

A Publication of the IUCN/SSC Conservation Breeding Specialist Group
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124 USA

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

TABLE OF CONTENTS

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

EXECUTIVE SUMMARY

Of the 30 distinct Bovid taxa considered by participants during the Wild Cattle Conservation Assessment and Management Plan workshop, 18 species/subspecies (in various categories of threat according to Mace-Lande criteria) were assigned to one of 3 levels of captive programs:

Level 1	16 taxa (5 Critical, 9 Endangered and 2 Unknown)
Level 2	1 taxon (Vulnerable)
Level 3	1 taxon (Endangered)

Captive programs for three taxa were listed as "pending", meaning that recommendations for these taxa would be postponed until further information was available, either from survey, a PHVA, or other sources. The remaining nine taxa were identified as not requiring captive programs.

Target populations were computed for all 30 taxa during the Global Captive Action Recommendations workshop. Global captive population targets ranged from 0 to 488 individuals. In nine cases (30%), the target population is lower than the current global captive population indicating a recommendation to manage the captive population toward a decrease in numbers or for complete elimination from captive programs as part of a strategy to accommodate as many species/subspecies as possible of higher conservation priority. In the remaining 21 taxa (70%), the recommended target population constitutes a considerable increase in the current captive populations.

Regional information has been obtained from North America, Europe, Australasia and Africa. Each region currently maintains captive programs for several taxa:

North America	16 taxa
Europe	18 taxa
Australasia	4 taxa
Africa	8 taxa

In these four regions, captive programs currently exist for 19 (63.3%) of the 30 bovid taxa. However, of the 18 taxa recommended for captive management, only 7 (37%) are currently in captivity in one or more of these regions.

All calculations of Mace-Lande criteria and all recommendations are based on estimates of wild population numbers and trends and on estimates of habitat area and conditions. As with all CBSG programs, the GCAR process is continually evolving as additional workshops are held and as reports from completed workshops are reviewed. Similarly, the GCAR document is a "living" set of guidelines, meaning that it will be reassessed and revised continually based upon new information and shifting needs. As additional regional information regarding current and planned population sizes becomes available, it will be incorporated into this document and made available to the various regions of the zoo world to serve as a guide when planning or revising regional collections.

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Bruce Read, Danny Morris, Chuck Brady, Pat Thomas, Steve Shurter,
Marilyn Anderson, Naida Loskutoff, Larry Killmar, Jim Dolan, Lee Simmons,
David Wildt, and Onnie Byers

SECTION 1

GLOBAL CAPTIVE ACTION RECOMMENDATIONS FOR WILD CATTLE

GLOBAL CAPTIVE ACTION RECOMMENDATIONS (GCAR) FOR WILD CATTLE

Introduction

Reduction and fragmentation of wildlife populations and habitat are occurring at a rapid and accelerating rate. For an increasing number of taxa, the results are small and isolated populations at risk of extinction. A rapidly expanding human population, now estimated at 5.25 billion, is expected to increase to 8 billion by the year 2025. This expansion and concomitant utilization of resources has momentum that cannot be stopped, the result being a decreased capacity for all other species to simultaneously exist on the planet.

As wildlife populations diminish in their natural habitat, wildlife managers realize that management strategies must be adopted that will reduce the risk of extinction. These strategies will be global in nature and will include habitat preservation, intensified information gathering, and in some cases, scientifically managed captive populations that can interact genetically and demographically with wild populations.

Within the Species Survival Commission (SSC) of IUCN-The World Conservation Union, the primary goal of the Conservation Breeding Specialist Group (CBSG) is to contribute to the development of holistic and viable conservation strategies and management action plans. Toward this goal, CBSG is collaborating with agencies and other Specialist Groups worldwide in developing scientifically-based processes, on both a global and regional basis, with the goal of facilitating an integrated approach to species management for conservation.

In addition to managing the natural habitat, conservation programs leading to viable populations may sometimes require a captive component. In general, captive populations and programs, or the use of captive technologies, can serve several roles in holistic conservation: 1) as genetic and demographic reservoirs that can be used to reinforce wild populations either by revitalizing populations that are languishing in natural habitats or by re-establishing by translocating populations that have become depleted or extinct; 2) providing scientific resources for information and technology that can be used to protect and manage wild populations; and 3) as living ambassadors that can educate the public and generate funds for *in situ* conservation.

It is proposed that, when captive populations or captive technology can assist species conservation, captive and wild populations should, and can be, intensively and interactively managed with feasible interchanges of animals occurring as needed. Captive populations should be a support, not a substitute, for wild populations. There may be problems with respect to disease, logistics and financial limitations. In the face of the immense extinction crisis facing many taxa, these issues must be addressed and resolved immediately.

Captive breeding programs have limited resources. Priorities must be developed cooperatively among all regions of the world for program development and resource allocation, the purpose of the Global Captive Action Recommendation process. Once global priorities are known, regional captive propagation programs can be developed or revised to assist in practical conservation.

Global Captive Action Recommendations (GCARs)

GCARs are derived from the Conservation Assessment and Management Plan (CAMP) process. The CAMP recommends which species/subspecies deserve attention, and the GCAR determines global priorities and a target number of individuals of each taxa needed to sustain a healthy world population. In addition, current distribution of the world's captive population is indicated in an effort to assist discussion, within individual regions, of regional responsibility for carrying out these captive management recommendations. This system assumes that captive populations be treated as an integral part of the metapopulations being managed by conservation strategies and action plans. Viable metapopulations may need to include captive components. The IUCN Policy Statement on Captive Breeding recommends, in general, that captive propagation programs be a component of conservation strategies for taxa in which the wild population is fewer than 1,000 individuals. Captive and wild populations should and can be intensively and interactively managed with interchanges of animals occurring as needed and as feasible, after appropriate analysis. There may be problems with interchanges including epidemiologic risks, logistic difficulties and financial limitations. However, limited but growing experience suggests that these problems can be resolved. Strategies and priorities should maximize options while minimizing regrets for species conservation.

Captive populations are a support and a reservoir, not a substitute, for wild populations. A primary focus of the GCAR is on captive propagation programs that can serve as genetic and demographic reservoirs to support survival and recovery of wild populations in the future. The purpose of the GCAR workshop is to provide strategic guidance for captive management enabling regional programs to interact and combine to catalyze a truly effective global effort. An important aspect is establishing global target population size goals (i.e., how many individuals ultimately to maintain). More specifically, GCARs recommend which taxa are most in need of captive propagation and thus:

1) which taxa in captivity should remain there,
2) which taxa not yet in captivity should be there, and
3) which taxa currently in captivity should no longer be maintained there.

There are multiple genetic and demographic objectives affecting the captive population target: some taxa require large population sizes for a long time, where others need small nuclei or reduced gene pools that can be expanded later, if needed. One result of the GCAR will be an ability to logically adjust current captive population sizes in various regions, hopefully to better sustain threatened taxa as well as to identify new space available for conserving other species/subspecies receiving insufficient attention.

In summary, the GCAR provides the strategic framework for establishing global priorities that, in turn, can be used by all regional taxon advisory groups to formulate, coordinate and implement effective Regional Collection Plans that together will have a true global conservation impact.

GCAR Workshop Goals

The goals of the Wild Cattle GCAR were:

1. to review CAMP data and discuss required changes;
2. to prioritize taxa in need of captive management and to identify global target population sizes; and
3. to evaluate the direction of regional collection plans on the basis of global conservation priorities identified by the GCAR process.

The GCAR Process

A major consideration in establishing priority species for captive management is the category of threat assigned to the taxon. Mace-Lande criteria (Mace & Lande, 1991) and the Draft IUCN Red List criteria, were applied to each taxon during the CAMP process. The Mace-Lande process assessed threat in terms of the likelihood of extinction within a specified time period and defines three categories:

Critical	50% probability of extinction within 5 years or two generations, whichever is longer
Endangered	20% probability of extinction within 20 years or 10 generations, whichever is longer
Vulnerable	10% probability of extinction within 100 years

In assessing threat according to Mace-Lande criteria, workshop participants also used information on the status and interaction of habitat and other characteristics (Table 1). Information about population trends, fragmentation, range, and stochastic environmental events, real and potential, also were considered. The number of wild cattle taxa in the wild by range country or region and by Mace-Lande category of threat is presented in Table 3. All Mace-Lande category assignments and all recommendations are based on estimates of wild population numbers and trends and on estimates of habitat area and conditions.

Table 1. Mace-Lande categories and criteria for threat.

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

Draft IUCN Red List Categories

The threatened species categories now used in IUCN Red Data Books and Red Lists have been in place, with some modification, for almost 30 years (Mace *et al.*, 1994). The Mace-Lande criteria is one developmental step in an attempt to make those categories more explicit. These criteria subsequently have been revised and formulated into new Draft IUCN Red List Categories, which also are being tested in the CAMP process.

The Draft IUCN Red List Categories (Table 2) provide a system which facilitates comparisons across widely different taxa, and is based both on population and distribution criteria. Like the Mace-Lande criteria, the new criteria can be applied to any taxonomic unit at or below the species level, with sufficient range among the different criteria to enable the appropriate listing of taxa from the complete spectrum of taxa, with the exception of micro-organisms (see Mace *et al.*, 1994, in Section 4).

The categories of Critical, Endangered, and Vulnerable are all nested (i.e., if a taxa qualifies for Critical, it also qualifies for Endangered and Vulnerable). This system introduces a new category of threat "Susceptible." The Draft IUCN Red List Categories are:

EXTINCT (EX)

A taxon is **Extinct** when there is no reasonable doubt that its last individual has died.

EXTINCT IN THE WILD (EW)

A taxon is **Extinct in the Wild** when it is known only to survive in cultivation, in captivity or as a naturalized population (or population) well outside the past range.

CRITICAL (CR)

A taxon is **Critical** when it is facing an extremely high risk of extinction in the wild in the immediate future as defined by Table 4 criteria.

ENDANGERED (EN)

A taxon is **Endangered** when it is not Critical but is facing a high risk of extinction in the wild in the near future, as defined by Table 4 criteria.

VULNERABLE (VU)

A taxon is **Vulnerable** when it is not Critical or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by Table 4 criteria.

CONSERVATION DEPENDENT (CD)

Taxa not currently qualifying under any of the categories above may be classified as **Conservation Dependent**. To be **Conservation Dependent**, a taxon must be the focus of a continuing taxon-specific or habitat-specific conservation program that directly affects the taxon. The cessation of this program would result in the taxon qualifying for one of the

threatened categories above.

SUSCEPTIBLE (SU)

A taxon is **Susceptible** when it does not qualify as Critical, Endangered, Vulnerable or Conservation Dependent, but there is serious and acute restriction in its area of occupancy (typically < 100 km^2) or in the number of locations (typically <5). Such a taxon thus is prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a short period of time in an unforeseeable future. Taxa in this category are capable of quickly becoming Critical or even Extinct.

LOW RISK (LR)

A taxon is **Low Risk** when it has been evaluated and does not qualify for any of the categories Critical, Endangered, Vulnerable, Susceptible, Conservation Dependent or Data Deficient (see below).

DATA DEFICIENT (DD)

A taxon is **Data Deficient** when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

NOT EVALUATED (NE)

A taxon is **Not Evaluated** when it has not yet been assessed against the criteria.

Table 2. DRAFT IUCN RED LIST CATEGORIES

ANY of the following criteria may be used to assign categories:	CRITICAL	ENDANGERED	VULNERABLE
Population reduction	≥ 80% decline in last 10 yrs based on:	≥ 50% decline in last 10 yrs or 2 generations based on:	≥ 50% decline in last 20 yrs or 5 generations based on:
	a) direct observation OR b) decline in area of occupancy, occurrence and/or habitat quality OR c) actual or potential levels of exploitation OR d) introd. taxa, hybridization, pathogens, pollutants, competitors or parasites		
	OR	OR	OR
	≥ 80% decline/10yrs predicted in near future	≥ 50% decline/10 yrs or 2 generations predicted in near future	≥ 50% decline/20 yrs or 5 generations predicted in near future
Extent of occurrence	Est. <100 km^2 or area of occupancy est. <10 km^2, AND TWO of the following:	Est. <5,000 km^2 or area of occupancy est. <500 km^2, AND TWO of the following:	Est. <20,000 km^2 or area of occupancy est. <2,000 km^2, AND TWO of the following:
	Severely fragmented OR single location.	Severely fragmented OR ≤ 5 locations	Severely fragmented OR ≤ 10 locations
	Decline in ANY of the following: a) extent of occurrence b) area of occupancy c) area, extent, and/or quality of habitat d) # of locations or subpopulations e) # of mature individuals		
	Extreme fluctuations in ANY of the following: a) extent of occurrence b) area of occupancy c) # of locations or subpopulations		
Population estimates	Est. <250 mature indivs. AND:	Est. <2,500 mature indivs. AND:	Est. <10,000 mature indivs. AND:
	Decline ≥25% within 3 yrs or one generation, whichever is longer	Decline ≥15% within 5 yrs or 2 generations, whichever is longer	Decline ≥20% within 10 yrs or 3 generations, whichever is longer
	OR	OR	OR
	Decline in mature individuals AND population structure EITHER a) no pop. w/>50 mature indivs. OR b) all indivs. in single subpop.	Decline in mature individuals AND population structure EITHER a) no pop. w/>250 mature indivs. OR b) all indivs. in single subpop.	Decline in mature individuals AND population structure EITHER a) no pop. w/>1,000 mature indivs. OR b) all indivs. in single subpop.
# of mature individuals	Est. < 50 mature individuals	Est. < 250 mature individuals	Est. < 1,000 mature individuals
Probability of extinction	≥ 50% within in 5 yrs or 2 generations, whichever is longer	≥ 20% within 20 yrs or 5 generations, whichever is longer.	≥ 10% within 100 yrs

Table 3. Number of bovid taxa in the wild by range country or region and by Mace-Lande category of threat.

REGION/ COUNTRY	MACE/LANDE CATEGORY					TOTAL
	CRITICAL	ENDANG	VULNER	SECURE	UNKN	
S & C AMERICA	0	0	0	0	0	0
SE ASIA	4	9	0	0	5	18
N. AMERICA	0	1	0	1	0	2
EUROPE	0	0	1	0	1	2
INDIA	1	2	0	0	1	4
CHINA	0	0	0	0	0	0
JAPAN	0	0	0	0	0	0
AUSTRALASIA	0	0	0	0	0	0
AFRICA	0	0	0	2	0	2
TOTAL	5	12	1	3	7	28

** some taxa were assigned to more than one region

When *ex situ* management was recommended, the 'level' of captive program was also determined, reflecting status, prospects in the wild and taxonomic distinctiveness. The captive levels used during the CAMP workshop are defined below.

Level 1 (1) - A captive population is recommended as a component of a conservation program. This program has a tentative goal of developing and managing a population sufficient to preserve 90% of the genetic diversity of a population for 100 years (90%/100). The program should be further defined with a species management plan encompassing the wild and captive populations and implemented immediately with available stock in captivity. If the current stock is insufficient to meet program goals, a species management plan should be developed to specify the need for additional founder stock. If no stock is present in captivity then the program should be developed collaboratively with appropriate wildlife agencies, SSC Specialist Groups and cooperating institutions.

Level 2 (2) - Similar to the above, except a species/subspecies management plan would include periodic reinforcement of captive population with new genetic material from the wild. The levels and amount of genetic exchange needed should be defined in terms of the program goals, a population model and species management plan. It is anticipated that periodic supplementation with new genetic material will allow

management of a smaller captive population. The time period for implementation of a Level 2 program will depend on recommendations made at the CAMP workshop.

Other captive recommendations include:

Level 3 (3) - A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies, but is recommended for education, research or husbandry.

No (N) - A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies. Taxa already held in captivity may be included in this category. In this case, species/subspecies should be evaluated either for management toward a decrease in numbers or for complete elimination from captive programs as part of a strategy to accommodate as many species/subspecies as possible of higher conservation priority as identified in the CAMP or in SSC Action Plans.

Pending (P) - A decision on a captive program will depend upon further data either from a Population and Habitat Viability Assessment (PHVA), a survey or existing identified sources to be queried.

Levels of Captive Programs Recommended for Wild Cattle Taxa

All 30 bovid taxa were evaluated for possible inclusion in captive propagation programs based on data generated from the CAMP tables. The number of wild cattle taxa in the wild by range country or region and by level of captive program recommended is shown in Table 4. Seventeen (56.7%) taxa were recommended for a Level 1 program because of their precarious status in the wild, both in terms of extremely low population numbers and the quality and/or availabilty of suitable habitat. One taxon (3.3%) was identified as requiring a less intensive, Level 2, captive management program. The wild population of this taxa, while small, is increasing and there is no immediate threat to the environment. Three taxa (10%) have established captive populations, but were classified as 'Pending' because the genetic make-up of these populations has not yet been defined. Long-term decisions regarding these animals will be made once subspecies or hybrid status has been determined. In the case of two of these taxa, current genetic analysis either is in progress or is scheduled to begin in the near future. The remaining five taxa (16.7%) were not recommended for captive breeding because wild populations are stable, and there appears to be no immediate threat to habitat. Table 5 presents a summary of bovid taxa recommended for captive population by Mace/Lande category of threat and type of captive program recommended. Table 6 presents the same information but only for taxa currently represented in captivity.

Table 4. Number of bovid taxa in the wild by range country or region and by level of

captive management recommended.

REGION/ COUNTRY	TYPE OF CAPTIVE PROGRAM					TOTAL
	LEVEL 1	LEVEL 2	LEVEL 3	PENDING	NO PROG	
S & C AMERICA	0	0	0	0	0	0
SE ASIA	13	0	1	3	1	18
N. AMERICA	0	0	0	0	2	2
EUROPE	0	1	0	0	1	2
INDIA	3	0	0	0	1	4
CHINA	0	0	0	0	0	0
JAPAN	0	0	0	0	0	0
AUSTRALASIA	0	0	0	0	0	0
AFRICA	0	0	0	0	2	2
TOTAL	16	1	1	3	7	28

Table 5. Summary of bovid taxa recommended for captive populations by Mace-Lande category of threat and type of captive population recommended.

MACE/LANDE	CAPTIVE POPULATION TYPES RECOMMENDED						TOTALS FOR LEVELS 1-3
	TAXA	LEVEL 1	LEVEL 2	LEVEL 3	PENDING	NO PROG	
CRITICAL	5	5	0	0	0	0	5
ENDANGERED	11	9	0	1	0	1	10
VULNERABLE	1	0	1	0	0	0	1
SECURE	3	0	0	0	0	3	0
UNKNOWN	8	2	0	0	3	3	2
TOTAL	28	16	1	0	3	8	18

Table 6. Summary of bovid taxa recommended for captive populations and represented in captivity by Mace-Lande category of threat and type of captive population recommended.

MACE/LANDE	CAPTIVE POPULATION TYPES RECOMMENDED						TOTALS FOR LEVELS 1-3
	TAXA	LEVEL 1	LEVEL 2	LEVEL 3	PENDING	NO PROG	
CRITICAL	2	2	0	0	0	0	2
ENDANGERED	8	6	0	1	0	1	7
VULNERABLE	1	0	1	0	0	0	1
SECURE	2	0	0	0	0	2	0
UNKNOWN	7	0	0	0	3	4	0
TOTAL	20	8	1	1	3	7	10

The wild cattle GCAR process involved (and will further involve in the future) considering all these relevant data in intensive and interactive discussion involving experts representing the various organized regions of the zoo world. The objectives are systematic decision-making (as a result of working through the GCAR process), captive program prioritization, initial selection of global species target population sizes and identification of regional distribution of each taxon. This is followed by determining which species/subspecies and the estimated number of individual animals that should be included in captivity globally (target population size).

Determining Global Target Populations Using CAPACITY 3

The GCAR workshop participants considered all relevant data in intensive and interactive discussion. The objectives were systematic decision-making, captive program prioritization, initial selection of global species target population sizes and identification of regional distribution of each taxon. Second, a determination needed to be made about which species/subspecies, and how many individual animals of each, should be included in this global captive program. Target population sizes were computed using the program CAPACITY 3 (Ballou, 1992).

Using the CAPACITY program, global target population sizes were determined to achieve the captive program goals recommended for a particular taxon. The CAMP and GCAR processes attempt to achieve a goal of maintaining 90% of the program's original founder's heterozygosity for 100 years. Other program parameters that are set and manipulated included:

1. generation length

2. annual growth rate of the population
3. size of the current captive population and effective population size
4. the estimated effective population size/total population size (Ne/N) ratio
5. percentage diversity retained to date
6. current year

General steps used for computing global target population numbers using Ballou's Capacity Program 3.0:
1. Calculate the N by assessing the total number of individuals in captivity (from the ISIS TAG report).
2. Estimate the generation length by determining the median between the earliest age of reproduction and oldest age for reproduction, adjusting for decreasing reproduction with increasing age, if applicable.
3. Determine the crude lambda value which is the projected growth rate of the population under ideal conditions. If no better data are available, lambda can be estimated as the crude rate of change (CRC) found in the ISIS TAG report. When the CRC value is less than 1.0, it is necessary to artificially increase lambda to 1.1.
4. Determine the Ne as the number of living breeders (LivBr) taken from the ISIS TAG report, unless more accurate data are available.
5. Calculate the Ne/N) by dividing the number of living breeders by the total number in captivity.
6. Consider 100% diversity at the onset of the program and the current year as 0 unless the population has been in captivity for a period of time and the loss of genetic diversity is known.
7. Using the above parameters, the target populations are computed for different program lengths (50, 100, 150, 200 years). All world target numbers are based on a 100 year management program with 90% retention of heterozygosity.
8. In some cases, it may be necessary to modify the variables of effective population size (i.e., the number of available animals may be too few to establish a viable program, and it will be necessary to plan to import new founders into the management program).
9. When more accurate information is available (from current international studbooks, for example), those data should be used in place of ISIS values.
10. It in imperative that all details involving the computation of global target populations are documented and included in the final GCAR report.

These steps were used to estimate global population size recommendations for each of the bovid species/subspecies recommended for captivity (Table 10). The specific assumptions made when calculating world target populations for wild cattle taxa are as follows:

Bubalus arnee (Asian water buffalo): The existing population (n = 141) was sufficient to initiate a world population target. Using the existing crude rate of change (CRC), the world target population was calculated to be 179 for a 100 year program maintaining 90% of the

original heterozygosity.

Bubalus arnee arnee: The existing population (n = 27) was sufficient to initiate a world population target. Using the existing CRC and a modified effective population size (changed from 11 to 15 by increasing the number of breeders and increasing reproductive efficiency in the existing population; not supplementing from the wild), the world target population was calculated to be 269 for a 100 year program maintaining 90% of the original heterozygosity.

Bubalus arnee hosei: The existing population (n = 14) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.10 because a lower value was insufficient to provide a target), the world target population was calculated to be 157 for a 100 year program maintaining 90% of the original heterozygosity.

Bubalus depressicornis (lowland anoa): The existing population (n = 43) was sufficient to initiate a world population target. Using the existing CRC, the world target population was calculated to be 486 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bubalus mindorensis (tamaraw): There were no animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1, and the effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity. This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Bos gaurus (gaur): The existing population (n = 103) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.1 because a lower value was insufficient to provide a target), the world target population was calculated to be 173 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos gaurus readei: There were insufficient animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1 and the effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity. This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Bos gaurus hubbacki: There were insufficient animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1 and the

effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity. This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Bos javanicus (banteng): The existing population (n = 40) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.1 because a lower value was insufficient to provide a target) and an increased effective population size (to 13, by increasing the number of breeders and reproductive efficiency in the extant population), the world target population was calculated to be 345 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos javanicus (Bali cattle): The existing population (n = 131) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.1 because a lower value was insufficient to provide a target) and an increased effective population size (to 43, by increasing the number of breeders and reproductive efficiency in the extant population), the world target population was calculated to be 179 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos javanicus javanicus: The existing population (n = 73) was sufficient to initiate a world population target. Using the existing CRC, the world target population was calculated to be 141 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos javanicus birmanicus: The existing population (n = 23) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.25 because a lower value was insufficient to provide a target) and an increased effective population size (to 12, by increasing the number of breeders and reproductive efficiency in the extant population), the world target population was calculated to be 175 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos javanicus lowi: There are no animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1 and the effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity
This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Bos mutus: The existing population (n = 24) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.1 because a lower value was insufficient to provide a target), the world target population was calculated to be 380 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Bos sauveli (kouprey): There are no animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1, and the effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity.
This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Bison bonasus (European bison): The existing population (n = 70) was sufficient to initiate a world population target. Using a modified CRC (increased to 1.1 because a lower value was insufficient to provide a target), the world target population was calculated to be 107 for a 100 year program maintaining 90% of the original genetic heterozygosity.

Pseudoryx nghtinhensis: There were no animals in captivity, and so the managed population had to be modeled. The founding population was determined to be 20 new founders with a generation length of 8.0 years. The CRC was estimated to be 1.1, and the effective population size was considered to be 12 individuals. Then, the world target population was calculated to be 225 for a 100 year program maintaining 90% of the original genetic heterozygosity. This estimate is based upon the assumption that all new founders contribute equally, and the target is achieved as rapidly as possible.

Regional Responsibilities
The last step of the GCAR is for individual regions to begin to define specific interest in each recommended species/subspecies, information that later will drive regional responsibilities (i.e., the development of Regional Collection Plans) to preserve an overall viable world populaiton. GCAR spreadsheets are constructed with columns for identification of regions currently holding the taxon and the number of specimens in captivity within that region (Table 11). Tables 7-10 present regional captive population information for North America and Australasia. **These tables will be completed as each region reviews this GCAR document.**

Depending on the current captive population distribution and the global target recommendations for the taxon, regional populations targets can be set, or current targets revised, by each organized region of the zoo and aquarium community on the basis of global conservation need.

Table 7. Current numbers of bovid taxa in regional captive populations by Mace-Lande category of threat.**

REGION/ COUNTRY	MACE/LANDE CATEGORY					TOTAL
	CRITICAL	ENDANG	VULNER	SECURE	UNKN	
S & C AMERICA						
SE ASIA						
N. AMERICA	0	6	1	3	6	16
EUROPE	1	6	1	3	7	18
INDIA						
CHINA						
JAPAN						
AUSTRALASIA	0	0	0	1	3	4
AFRICA	0	1	1	2	4	8
TOTAL						

** some taxa were assigned to more than one region
This table will be completed as each region reviews this GCAR document.

Table 8. Current numbers of bovid specimens in regional captive populations by Mace-Lande category of threat.**

REGION/ COUNTRY	MACE/LANDE CATEGORY					TOTAL
	CRITICAL	ENDANG	VULNER	SECURE	UNKN	
S & C AMERICA						
SE ASIA						
N. AMERICA	0	143	11	184	544	882
EUROPE	25	97	50	33	365	570
INDIA						
CHINA						
JAPAN						
AUSTRALASIA	0	0	0	8	205	213
AFRICA	0	5	3	28	30	66
TOTAL						

** some taxa were assigned to more than one region
This table will be completed as each region reviews this GCAR document.

Table 9. Number of bovid taxa held in regional captive populations and by level of captive management recommended.

REGION/ COUNTRY	TYPE OF CAPTIVE PROGRAM					TOTAL
	LEVEL 1	LEVEL 2	LEVEL 3	PENDING	NO PROG	
S & C AMERICA						
SE ASIA						
N. AMERICA	5	1	0	2	8	16
EUROPE	6	1	0	2	9	18
INDIA						
CHINA						
JAPAN						
AUSTRALASIA	0	0	0	1	3	4
AFRICA	1	1	0	1	5	8
TOTAL						

This table will be completed as each region reviews this GCAR document.

Table 10. Current numbers of bovid specimens in regional captive populations by level of captive management recommended.

REGION/ COUNTRY	TYPE OF CAPTIVE PROGRAM					TOTAL
	LEVEL 1	LEVEL 2	LEVEL 3	PENDING	NO PROG	
S & C AMERICA						
SE ASIA						
N. AMERICA	113	11	0	107	651	882
EUROPE	109	50	0	39	372	570
INDIA						
CHINA						
JAPAN						
AUSTRALASIA	0	0	0	131	82	213
AFRICA	5	3	0	11	47	66
TOTAL						

This table will be completed as each region reviews this GCAR document.

This FIRST REVIEW DRAFT Wild Cattle GCAR report will be distributed by the CBSG to all participants and to TAG chairs and Species Conservation Coordinators for review and comments. The intent is to facilitate regional interaction to optimize the use of captive space and resources for international conservation. It should be re-emphasized that the GCAR document is a "living" set of guidelines, meaning that it will be reassessed and revised continually based upon new information and shifting needs.

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Bruce Read, Danny Morris, Chuck Brady, Pat Thomas, Steve Shurter, Marilyn Anderson, Naida Loskutoff, Larry Killmar, Jim Dolan, Lee Simmons, David Wildt, and Onnie Byers

SECTION 2

GCAR SPREADSHEET CATEGORY DEFINITIONS AND SPREADSHEET

GLOBAL CAPTIVE ACTION RECOMMENDATIONS (GCAR) SPREADSHEET CATEGORIES

The Global Captive Action Recommendations (GCAR) spreadsheet is a working document that provides information to be used for assessing degree of threat and recommending conservation action. The first section of the spreadsheet summarizes information (usually gathered during the Conservation Assessment and Management Plan, CAMP, Workshop) on wild population status and level of captive program recommended for each taxon. This information can be used to identify priorities for captive management action.

TAXON

SCIENTIFIC NAME: Scientific names of extant taxa: genus, species, subspecies.

WILD POPULATION

EST #: Estimated numbers of individuals in the wild. If specific numbers are unavailable, general range of the population size is estimated.

M/L STS: Status according to Mace/Lande criteria (see explanation, pg. 4).

C = Critical
E = Endangered
V = Vulnerable
S = Secure
EXT = Extinct

IUCN: Status according to draft IUCN Red List criteria (see explanation, pg. 7).

EX = Extinct
EW = Extinct in the Wild
CR = Critical
EN = Endangered
VU = Vulnerable
CD = Conservation Dependent
SU = Susceptible
LR = Low Risk
DD = Data Deficient
NE = Not Evaluated

CAPTIVE PROGRAM RECOMMENDATIONS

Recommendation:	**Level of Captive Program:**
Level 1 (1)	A captive population is recommended as a component of a conservation program. This program has a tentative goal of developing and managing a population sufficient to preserve 90%

of the genetic diversity of a population for 100 years (90%/100). The program is further defined with a species management plan encompassing the wild and captive populations and implemented immediately with available stock in captivity. If the current stock is insufficient to meet program goals, a species management plan should be developed to specify the need for additional founder stock. If no stock is present in captivity, then the program should be developed collaboratively with appropriate wildlife agencies, SSC Specialist Groups and cooperating institutions.

Level 2 (2) Similar to 'Level 1' except a species/subspecies management plan includes periodic reinforcement of the captive population with new genetic material from the wild. The levels and amount of genetic exchange needed should be defined in terms of the program goals, a population model and species management plan. It is anticipated that periodic supplementation with new genetic material will allow management of a smaller captive population. The time period for implementation of a Level 2 program will depend on recommendations made at the CAMP workshop.

Level 3 (3) A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies but is recommended for education, research, or husbandry.

No (N) A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species or subspecies. Taxa already held in captivity may be included in this category. In this case, species/subspecies should be evaluated either for management toward a decrease in numbers or for complete elimination from captive programs. This will assist in accommodating more species/subspecies of higher conservation priority (as identified in the CAMP or in SSC Action Plans).

Pending (P) A decision on a captive program will depend upon further data either from a PHVA, a survey or existing identified sources to be queried.

WORLD

The information entered into this section of the GCAR spreadsheet defines the current global captive population and will be used to calculate target populations for each taxon recommended for captive management.

N: Size of the current captive population

Gen Lgth: Generation length

Ne: Effective population size

Lambda: Annual growth rate of the population

Trg Pop: Target population size computed using Ballou's CAPACITY program. This is the proposed number of individuals that must be maintained in captivity to achieve the level of captive program recommended for that taxon.

DISTRIBUTION OF CAPTIVE POPULATION

Loc: Location of a captive population of a particular taxon. This can be one of the organized regions of the zoo and aquarium world, a region not represented by a formal zoo association or a specific country holding that taxon.

Pop: The number of individuals of a particular taxon currently maintained in the specified region.

Table 11. **GLOBAL CAPTIVE ACTION RECOMMENDATIONS FOR WILD CATTLE**

	TAXON		CAMP DATA				WORLD					DISTRIBUTION OF CAPTIVE POPULATION													
CODE	SCIENTIFIC NAME		WILD EST#	M/L	IUCN	REC	N	Gen Lgth	Ne	Lambda	Trg Pop	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop
1	Bubalus	arnee	?	?	NE	N	141	8	46	1.02	17	N. Amer	68	N	ASMP*	25	8	Europe	34		Africa	9			
2	Bubalus	arnee (undefined subsp.)	< 300	E	EN	1	0	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
3	Bubalus	arnee fulvus	< 800	E	EN	1	0	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
4	Bubalus	arnee migona	?	?	NE	1	0	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
5	Bubalus	arnee arnee	2000	C	EN	1	27	8	11	1.06	269	N. Amer			ASMP			Europe	25		Africa				
6	Bubalus	arnee hosei	< 150	C	NE	1	14	8	4	> 1.00	587	N. Amer			ASMP			Europe			Africa				
7	Bubalus	depressicornis	1500	E	EN	1	51	8	18	1.04	488	N. Amer	16		ASMP			Europe	35		Africa				
8	Bubalus	quarlesi	1500	E	EN	1	9	8	NA	NA	225	N. Amer	3		ASMP			Europe	6		Africa				
9	Bubalus	mindorensis	250	C	EN	1	0	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
10	Syncerus	cafer cafer	> 500,000	S	NE	N	56	8	NA	NA	0	N. Amer	25	0	ASMP			Europe	12		Africa	23			
11	Syncerus	cafer nanus	>10,000	S	NE	N	73	8	NA	NA	0	N. Amer	16	0	ASMP	8	15	Europe	12		Africa	5			
12	Bos	gaurus (no subspecies)	?	?	NE	P	116	8	45	>1.00	134	N. Amer	94	P	ASMP			Europe	20		Africa				
13	Bos	gaurus gaurus	3500	E	VU	1	41	8	18	>1.00	173	N. Amer	31		ASMP			Europe	5		Africa	5			
14	Bos	gaurus readei	<1500	E	EN	1	3	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
15	Bos	gaurus hubbacki	<500	E	EN	3	11	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
16	Bos	gaurus frontalis	?	?	NE	NO	38	8	NA	NA	0	N. Amer			ASMP			Europe	16		Africa	2			
17	Bos	javanicus	?	?	NE	P	40	8	NA	>1.00	345	N. Amer	13		ASMP			Europe	19		Africa	11			
18	Bos	javanicus (Bali Cattle)	?	?	NE	P	131	8	NA	>1.00	179	N. Amer			ASMP	131	140	Europe			Africa				
19	Bos	javanicus javanicus	<1500	E	EN	1	77	8	32	1.12	141	N. Amer	48	P	ASMP			Europe	29		Africa				
20	Bos	javanicus birmanicus	<1500	E	EN	1	23	8	NA	>1.00	173	N. Amer			ASMP			Europe			Africa				
21	Bos	javanicus lowi	<600	E	EN	1	0	8	NA	NA	225	N. Amer			ASMP			Europe			Africa				
22	Bos	mutus (wild)	2500	E	EN	1	24	8	11	>1.00	380	N. Amer	15		ASMP			Europe	9		Africa				

	TAXON		CAMP DATA				WORLD					DISTRIBUTION OF CAPTIVE POPULATION												
CODE	SCIENTIFIC NAME		WILD EST#	M/L	IUCN	REC	N	Gen Lgth	Ne	Lambda	Trg Pop	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop	Trg	Loc	Pop
23	Bos	mutus grunniens (domestic)	?	?	?	NO	14	8	NA	NA	0	N. Amer	37	0	ASMP			Europe	95		Africa				
24	Bos	sauveli	<200	C	EN	1	0	NA	NA	NA	225	N. Amer			ASMP			Europe			Africa				
25	Bison	bison (Generic Bison)	?	?	NE	NO	435	NA	NA	NA	0	N. Amer	305	0	ASMP	49	61	Europe	81		Africa	8			
26	Bison	bison bison (Plains bison)	>7500	S	NE	NO	153	NA	NA	NA	0	N. Amer	143	0	ASMP			Europe	9		Africa				
27	Bison	bison athabascae (Wood Bison)	1000	E	NE	NO	43	NA	NA	NA	0	N. Amer	30	0	ASMP			Europe	13		Africa				
28	Bison	bonasus	?	?	NE	NO	127	NA	NA	NA	0	N. Amer	27	0	ASMP			Europe	100		Africa				
29	Bison	bonasus bonasus	>2800	V	VU	2	73	8	39	>1.00	107	N. Amer	11	0	ASMP			Europe	50		Africa	3			
30	Pseudoryx	nghtinhensis	<200	C	NE	1	0	NA	NA	NA	225	N. Amer			ASMP			Europe			Africa				

* ASMP: Australasian Species Management Program

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Bruce Read, Danny Morris, Chuck Brady, Pat Thomas, Steve Shurter, Marilyn Anderson, Naida Loskutoff, Larry Killmar, Jim Dolan, Lee Simmons, David Wildt, and Onnie Byers

SECTION 3

WORKSHOP PARTICIPANTS

Wild Cattle Working Group Participants

Danny Morris
Omaha's Henry Doorly Zoo
3701 South 10th Street
Omaha, NE 68107-2200
Ph: 402-733-8401
Fax: 402-733-4415

Chuck Brady
Memphis Zoological Garden and Aquarium
2000 Galloway Avenue
Memphis, TN 38112-9990
Ph: 901-725-3419
Fax: 901-725-9305

Pat Thomas
New York Zoological Park
185th Street & Southern Boulevard
Bronx, NY 10460-1099
Ph: 718-220-5161
Fax: 718-365-0307

Steve Shurter
White Oak Conservation Center
726 Owens Road
Yulee, FL 32097-9807
Ph: 904-225-3316
Fax: 904-225-3339

Marilyn Anderson
Zoological Society of San Diego
PO Box 551
San Diego, CA 92112
Ph: 619-231-1515x4223
Fax: 619-239-4516

Bruce Read
St. Louis Zoological Park
Forest Park
St. Louis, MO 63110
Ph: 314-781-0900x210
Fax: 314-647-7969

Naida Loskutoff
Omaha's Henry Doorly Zoo
3701 South 10th Street
Omaha, NE 68107-2200
Ph: 402-733-8401
Fax: 402-733-4415

Larry Killmar
San Diego Zoo/Wild Animal Park
15500 San Pasquel Valley Rd.
Escondido, CA 92027
Ph: 619-738-5056
Fax: 619-480-9573

Jim Dolan
San Diego Zoo/Wild Animal Park
PO Box 551
San Diego, CA 92112
Ph: 619-738-5013
Fax: 619-557-3981

David Wildt
National Zoo
3001 Connecticut Avenue
Washington D.C. 20008
Ph: 202-673-4793
Fax: 202-673-4733

Lee Simmons
Omaha's Henry Doorly Zoo
3701 South 10th Street
Omaha, NE 68107-2200
Ph: 402-733-8401
Fax: 402-733-4415

Regional information provided by:
Christine Hopkins, ASMP
John Spence, PAAZAB

WILD CATTLE
GLOBAL CAPTIVE ACTION RECOMMENDATIONS

FIRST REVIEW DRAFT

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Bruce Read, Danny Morris, Chuck Brady, Pat Thomas, Steve Shurter, Marilyn Anderson, Naida Loskutoff, Larry Killmar, Jim Dolan, Lee Simmons, David Wildt, and Onnie Byers

SECTION 4

REFERENCE MATERIALS

DRAFT IUCN RED LIST CATEGORIES

Version 2.2

I) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their inception they have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them. The system has worked well under the existing definitions, and underlies many valuable conservation assessments and management plans. However, with the increasing recognition that the resources available for conservation are very limited and need to be allocated rationally among many different demands, the categories have been used more frequently for setting priorities for conservation action. It is this change in emphasis that has provoked recent moves to revise the category definitions.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter & Fitter 1987) which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1987 with a request from the SSC Steering Committee develop a new approach that would provide the conservation community with useful information for action planning.

The revision has several aims: to provide an explicit system that can be applied consistently by different people; to improve the objectivity by providing those using the criteria clear guidance on how to evaluate different factors which affect risk of extinction; to provide a system which will facilitate comparisons across widely different taxa; and to give people using threatened species lists a better understanding of how individual species were classified. In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an objective framework for the classification of species according to their extinction risk. This is intended to be equally applicable across taxa, and to be useful in the planning of conservation actions.

3. The proposals presented in this document result from a continuing process of drafting, consultation and validation exercises, and re-drafting. It is clear that the production of a large number of draft proposals has led to some confusion, especially as each draft has been used for classifying some set of species for conservation purposes. To clarify matters, and to open the way for future modifications as and when they become necessary, a system for version numbering is now being introduced as follows:

Version 1.0: Mace & Lande (1991)
The first paper discussing a new basis for the categories, and presenting numerical criteria especially relevant for large vertebrates.

Version 2.0: Mace et al (1992)
A major revision of Version 1.0, including numerical criteria appropriate to all organisms and introducing the non-threatened categories.

Version 2.1: IUCN (1993)
Following an extensive consultation process within SSC, a number of changes were made to the details of the criteria, and fuller explanation of basic principles was included. A more explicit structure clarified the significance of the non-threatened categories.

Version 2.2: this paper
Following further comments received and additional validation exercises, some minor

changes to the criteria have been made. In addition, the Susceptible category present in Versions 2.0 and 2.1 has been subsumed into the Vulnerable category. A precautionary application of the system is emphasised.

In future any application of the criteria should include the appropriate version number as given above.

4. In the rest of this document the proposed system is outlined in several sections. The Preamble presents some basic information about the context and structure of the proposal, and the procedures that are to be followed in applying the definitions to species. This is followed by a section giving definitions for terms used in a specific fashion within the definitions. Finally the definitions are presented, followed by the quantitative criteria used for classification within the threatened categories. It is important for the effective functioning of the new system that all sections are read and understood, and the recommendations followed by people applying the system.

References:

Fitter, R., and M. Fitter, ed. (1987) The Road to Extinction. Gland, Switzerland: IUCN.

IUCN. (1993) Draft IUCN Red List Categories. IUCN, Gland, Switzerland.

Mace, G. M. et al. (1992) "The development of new criteria for listing species on the IUCN Red List." Species 19.Dec. (1992): 16-22.

Mace, G. M., and R. Lande. (1991) "Assessing extinction threats: toward a reevaluation of IUCN threatened species categories." Conserv. Biol. 5.2: 148-157.

Scott, P., J. A. Burton, and R. Fitter (1987) "Red Data Books: the historical background." The Road to Extinction. pp 1-6. Ed. R. Fitter and M. Fitter. Gland, Switzerland: IUCN.

II) Preamble

The following points present important information on the use and interpretation of the categories (= Critically Endangered, Endangered, etc.), criteria (= A to E), and sub-criteria (= a,b etc., i,ii etc.):

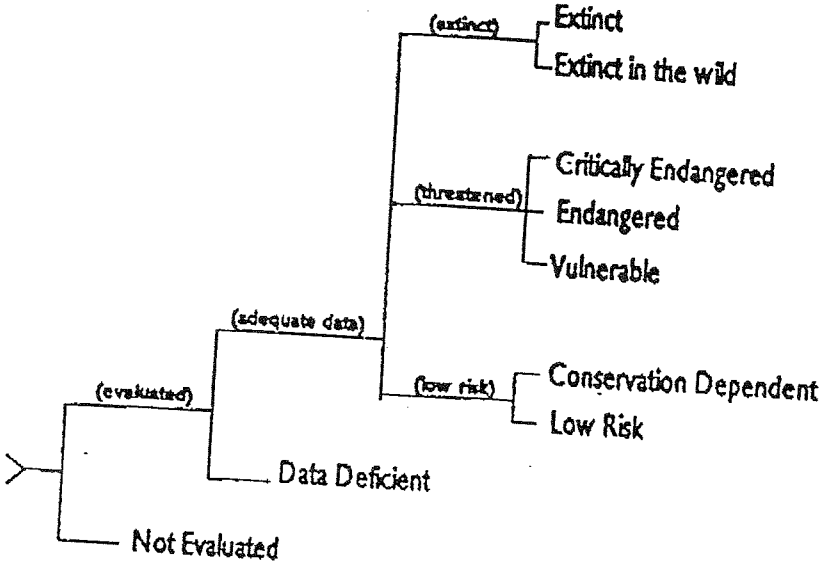
1. **Taxonomic level and scope of the categorisation process**

The criteria can be applied to any taxonomic unit at or below the species level. The term 'taxon' in the following notes, definitions and criteria is used for convenience, and may represent species or lower taxonomic levels, including forms that are not yet formally described. There is a sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area althoughspecial notice should be taken of point 11 below. In presenting the results of applying the criteria, the unit and area under consideration should be made explicit. The categorisation process should only be applied to wild populations reproducing naturally inside their natural range, and to populations resulting from benign introductions (defined in the draft IUCN Guidelines for Reintroductions as "..an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area") .

2. **Nature of the categories**

The categories of Critically Endangered, Endangered and Vulnerable are nested. Thus all taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened' .The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into at least one of the categories (see Figure 1).

Figure 1: Structure of the Categories



3. **Role of the different criteria**

For listing as Critically Endangered, Endangered or Vulnerable there are five quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. The different criteria (A-E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for particular taxa and some taxa will never qualify under particular criteria however close to extinction

they come, there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met.

4. Derivation of quantitative criteria

The quantitative values presented in the various criteria associated with threatened categories were developed through wide consultation and they are set at what are generally judged to be appropriate levels, even if no formal justification for these values exists. The levels for different criteria within categories were set independently but against a common standard. Some broad consistency between them was sought. However, a given taxon should not be expected to meet all (A-E) criteria in a category; meeting any one criterion is sufficient.

5. Implications of listing

Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it will be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened forms, at least until their status can be evaluated.

Extinction is seen as a probabilistic or chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames under consideration more taxa listed here are expected to go extinct (without effective conservation action) than taxa listed in the lower risk categories. However, the fact that some taxa listed at high risk persist, does not necessarily mean their initial assessment was inaccurate.

6. Data quality and the importance of inference and projection

The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be sufficient throughout. Inference and projection may be based on extrapolation of current or potential threats into the future and their rate of change, or on extrapolation of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified.

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by other criteria (e.g. small distributions, few locations). Many threats are most easily dealt with as soon as they are identified (pathogens, invasive organisms, hybridization) rather than waiting until they have caused damage which is irreversible, or nearly so.

7. Uncertainty

The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the lowest credible estimate.

Where data are insufficient to assign a category (including Low Risk), the category of 'Data Deficient' may be assigned. However, it is important to recognise that this category indicates that data are inadequate to determine the degree of threat faced by a taxon, not necessarily that the taxon is poorly known. In cases where there are evident threats to a taxon through, for example, deterioration of its only known habitat, it is important to attempt threatened listing, even though there may be little direct information on the biological status of the taxon itself. The category 'Data Deficient' is not a threatened category, although it indicates a need to obtain more information on such species to determine their appropriate listing.

8. Conservation actions in the listing process

The criteria for the threatened categories are to be applied to a taxon irrespective of whether conservation action is taking place. In cases where it is only conservation action that prevents the

taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon may be deserving of conservation action even if it is not listed as threatened.

9. Documentation

All taxon lists including categorisation resulting from these criteria should state the version number of the category definitions as well as the criteria and sub-criteria that were met. No listing can be accepted as valid unless at least one criterion is given. If more than one criterion or sub-criterion was met, then each should be listed. However, failure to mention a criterion should not necessarily imply that it was not met. Therefore, if a re-evaluation indicates that the documented criterion is no longer met, this should not result in automatic down-listing. Instead, the taxon should be re-evaluated with respect to all criteria to indicate its status. The factors responsible for triggering the criteria, especially where inference and projection are used, should at least be logged by the evaluator, even if they cannot be included in published lists.

10. Threats and priorities

The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the likelihood of extinction under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation action such as costs, logistics, chances of success, and even perhaps the taxonomic distinctiveness of the subject.

11. Use at regional level

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa that were classified as Vulnerable on the basis of their global declines in numbers or range might be Low Risk within a particular region where the population was stable. Conversely, taxa classified as Low Risk globally might be Critically Endangered within a particular region where numbers were very small or declining, perhaps only because they were at the margins of their global range.

12. Re-evaluation

Evaluation of taxa against the criteria should not be seen as a single event. As circumstances change, re-evaluation will be necessary, and listings should indicate explicitly the taxa for which re-evaluation should occur within a short time-frame (typically within 5 years), or under some specified circumstance. This is especially important for taxa listed under Low Risk, but which are close to qualifying as Vulnerable or Conservation Dependent.

13. Transfer between categories

There are some rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has applied for 5 years or more. (B) If the original classification is found to have been erroneous (based on reanalysis of the data or new information), the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay (but see Section 9). (C) Transfer from lower risk to higher risk categories of threat is immediate.

14. Problems of scale

Classification based on the sizes of geographic ranges or the patterns of habitat occupancy is complicated by problems of spatial scale. The finer the scale at which the distributions or habitats of taxa are mapped, the smaller will be the area that they are found to occupy. Mapping at finer scales reveals more areas in which the taxon is unrecorded. It is impossible to provide any strict rules for mapping taxa or habitats; the most appropriate scale will depend on the taxa in question, and the origin and comprehensiveness of the distributional data. However, the thresholds for some criteria (e.g. Critically Endangered) necessitate mapping at a fine scale (in units of one square kilometre).

III) Definitions

1. **Population**
Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa biologically dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. **Subpopulations**
Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

3. **Mature individuals**
The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. Where the population is characterised by normal or extreme fluctuations the minimum number should be used. This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild. In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account. Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals). In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. **Generation**
Generation may be measured as the average age of parents in the population.

5. **Continuing decline**
A continuing decline is a recent, current or projected future decline whose causes are not known or not adequately controlled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

6. **Severe decline**
A severe decline (criterion A) is a reduction in the number of mature individuals of at least the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A severe decline should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a severe decline.

7. **Extreme fluctuations**
Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, with a variation greater than one order of magnitude.

8. **Severely fragmented**
Severely fragmented is defined as the case where increased extinction risks result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

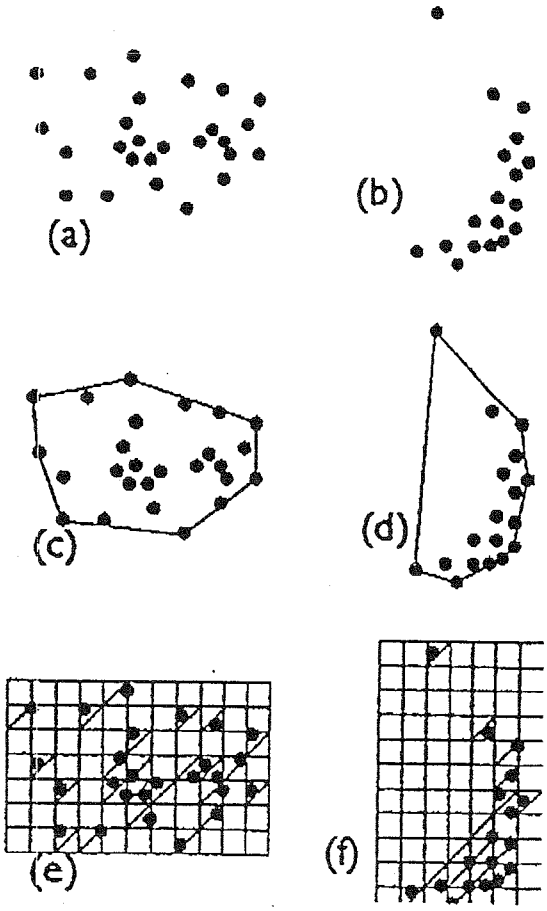
9. **Extent of occurrence**
Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure does not take account of discontinuities or disjunctions in the spatial distributions of taxa (but see 'Area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

10. **Area of occupancy**

Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of a taxon (e.g. colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon. The criteria include values in km², and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 2).

Figure 2:

Two examples of the distinction between extent of occurrence and area of occupancy. (a) and (b) are the spatial distribution of known, inferred or projected sites of occurrence. (c) and (d) show one possible boundary to the extent of occurrence, which is the measured area within this boundary. (e) and (f) show one measure of area of occupancy which can be measured by the sum of the occupie grid squares.



11. **Quantitative analysis**

A quantitative analysis is defined here as the technique of population viability analysis (PVA), or any other quantitative form of analysis, which estimates the extinction probability of a taxon or population based on the known life history and specified management or non-management options. In presenting the results of quantitative analyses the structural equations and the data should be explicit.

IV) The categories

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that its last individual has died.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on page 10.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on page 11.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E) on page 12.

CONSERVATION DEPENDENT (CD)
Taxa which do not currently qualify as Critically Endangered, Endangered or Vulnerable, may be classified as Conservation Dependent. To be considered Conservation Dependent, a taxon must be the focus of a continuing taxon-specific or habitat-specific conservation programme which directly affects the taxon in question. The cessation of this conservation programme would result in the taxon qualifying for one of the threatened categories above.

LOW RISK (LR)
A taxon is Low Risk when it has been evaluated and does not qualify for any of the categories Critically Endangered, Endangered, Vulnerable, Conservation Dependent or Data Deficient. It is clear that a range of forms will be included in this category including: (i) those that are close to qualifying for the threatened categories (i) those that are of less concern and (a) those that are presently abundant and unlikely to face extinction in the foreseeable future. It may be appropriate to indicate into which of these three classes taxa in Low Risk seem to fall. It is especially recommended to indicate an appropriate interval, or circumstance, before re-evaluation is necessary for taxa in the Low Risk class, especially for those indicated in (i) above.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. DD is therefore not a category of threat or Low Risk. Listing of taxa in this category indicates that more information is required. Listing a taxon as DD acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, or if there are reasonable chances of unreported surveys in which the taxon has not been found, or that habitat loss has had an unfavourable impact, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet assessed against the criteria.

V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

A taxon is **Critically Endangered** when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed , estimated, inferred or suspected severe decline of at least 80% during the last 10 years or 3 generations for which data are available, based on (and specifying) any of the following:

a) direct observation
b) a decline in area of occupancy, extent of occurrence and/or quality of habitat
c) actual or potential levels of exploitation
d) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A severe decline of at least the rate specified in A1 that is projected, observed, inferred or suspected to be likely to occur in the near future, based on (and specifying) any of (b), (c), or (d) above.

B) Extent of occurrence estimated to be less than 100 km² or area of occupancy estimated to be less than 10 km², and estimates indicating any two of the following:

1) Severely fragmented or found only at a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals .

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations

C) Population estimated to number less than 250 mature individuals and either:

1) An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either

a) severely fragmented (i.e. no population estimated to contain more than 50 mature individuals)
b) all individuals are in a single sub-population.

D) Population estimated to number less than 50 mature individuals .

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 5 years or 2 generations, whichever is the longer.

ENDANGERED (EN)

A taxon is **Endangered** when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of **either** of the following:

1) An observed , estimated, inferred or suspected **severe** decline of at least 50% during the last 10 years or three generations for which data are available, based on (and specifying) **any** of the following:

   a) direct observation
   b) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   c) actual or potential levels of exploitation
   d) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A severe decline of at least the rate specified in A1 that is projected, observed, inferred or suspected to be likely to occur in the near future, based on (and specifying) any of (b), (c), or (d) above.

B) Extent of occurrence estimated to be less than 5000 km² or area of occupancy estimated to be less than 500 km², and estimates indicating **any two of** the following:

1) Severely fragmented **or** found only at no more than five locations.

2) Continuing decline, inferred, observed or projected, **in any of** the following:

   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals .

3) Extreme fluctuations **in any of** the following:

   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations

C) Population estimated to number less than 2500 mature individuals and **either:**

1) An estimated continuing decline of at least 20% within 5 years or 2 generations, whichever is longer, **or**

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals **and** population structure in the form of **either**

   a) severely fragmented (i.e. no population estimated to contain more than 250 mature individuals)
   b) all individuals are in a single sub-population.

D) Population estimated to number less than 250 mature individuals .

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or 5 generations, whichever is the longer.

VULNERABLE (VU)

A taxon is **Vulnerable** when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by **any of** the following criteria (A to E):

A) Population reduction in the form of **either** of the following:

1) An observed , estimated, inferred or suspected severe decline of at least 50% during the last 20 years or 5 generations for which data are available, based on (and specifying) **any of** the following:

a) direct observation
b) a decline in area of occupancy, extent of occurrence and/or quality of habitat
c) actual or potential levels of exploitation
d) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A severe decline of at least the rate specified in A1 that is projected, observed, inferred or suspected to be likely to occur in the near future, based on (and specifying) any of (b), (c), or (d) above.

B) Extent of occurrence estimated to be less than 20,000 km² or area of occupancy estimated to be less than 2000 km², and estimates indicating **any two of** the following:

1) Severely fragmented **or** found at no more than ten locations.

2) Continuing decline, inferred, observed or projected, in **any of** the following:

a) extent of occurrence
b) area of occupancy
c) area, extent and/or quality of habitat
d) number of locations or subpopulations
e) number of mature individuals .

3) Extreme fluctuations in **any of** the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations

C) Population estimated to number less than 10,000 mature individuals and **either**:

1) An estimated continuing decline of at least 20% within 10 years or 3 generations, whichever is longer, **or**

2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals **and** population structure in the form of **either**

a) severely fragmented (i.e. no population estimated to contain more than 1000 mature individuals)
b) all individuals are in a single sub-population.

D) Population very small or restricted in the form of **either** of the following:

1) Population estimated to number less than 1000 mature individuals.

2) Population is characterised by an acute restriction in its area of occupancy (typically

less than 100 km²) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

11/5/94