TAPIR

Conservation Assessment & Management Plan

TAPIR CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

WORKING DOCUMENT

February 1995

Report from the workshop held
8-12 March 1994

Edited and Compiled by
Rick Barongi, Michael Dee, Lewis Greene, Donald L. Janssen,
Diane Ledder, Sharon Matola, Onnie Byers, and Susie Ellis

A Collaborative Workshop

SSC Tapir Specialist Group

AZA Tapir Taxon Advisory Group

IUCN/SSC Conservation Breeding Specialist Group

AZA

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A contribution of the IUCN/SSC Conservation Breeding Specialist Group, the IUCN/SSC Tapir Specialist Group, and the AZA Tapir Taxon Advisory Group.

The primary sponsor of the Workshop was the San Diego Zoo.

Cover Photo: Baird's Tapir (*Tapirus bairdii*), provided by Rick Barongi.

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24 March 1995

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CONSERVATION ASSESSMENT AND MANAGEMENT PLAN FOR TAPIRIDS EXECUTIVE SUMMARY

Seven distinct Tapir taxa (subspecies or species if no subspecies are contained therein) were considered by the Tapir Conservation Assessment and Management Plan. All seven taxa were assigned to one of three categories of threat, based on the Mace-Lande criteria:

Critical	1 taxon
Endangered	3 taxa
Vulnerable	3 taxa

All seven taxa were assigned to one of four draft IUCN Red List categories of threat:

Critical	1 taxon
Endangered	3 taxa
Vulnerable	1 taxon
Conservation Dependent	2 taxa

Tapirus terrestris terrestris was the only taxon not recommended for a Population and Habitat Viability Assessment (PHVA) workshop.

Twenty-seven recommendations for Research Management were made for all seven taxa in the following categories:

Survey	3 taxa
Monitoring	4 taxa
Limiting factors management	1 taxon
Habitat management	7 taxa
Taxonomic research	7 taxa
Translocation	2 taxa
Husbandry Research	3 taxa

For many taxa, more than one type of research management was recommended.

Three of the seven taxa (43%) were recommended for captive programs (based in part on Mace-Lande and draft IUCN Red List criteria):

Level 1	3 taxa

Captive programs for three taxa were listed as "pending," meaning that recommendations for such would be postponed until further information was available, either from survey, a PHVA, or from sources which need to be queried. *Tapirus terrestris terrestris* was the only subspecies identified as not requiring a captive program.

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Compiled by the Workshop Participants

SECTION 1

WORKSHOP SUMMARY AND RECOMMENDATIONS

TAPIR CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

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.

The successful preservation of wild species and ecosystems necessitates development and implementation of active management programs by people and governments living within the range area of the species in question. The recommendations contained within this document are based on conservation need only; adjustments for political and other constraints are the responsibility of regional governmental agencies charged with the preservation of flora and fauna within their respective countries.

Conservation Assessment and Management Plans (CAMPs)

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 the development of scientifically-based processes, on both a global and regional basis, with the goal of facilitating an integrated approach to species management for conservation. One of these tools is called Conservation Assessment and Management Plan (CAMP).

CAMPs provide strategic guidance for the application of intensive management techniques that are increasingly required for survival and recovery of threatened taxa. CAMPs are also one means of testing the applicability of the revised IUCN criteria for threat as well as the scope of its applicability. Additionally, CAMPs are an attempt to produce ongoing summaries of current data for groups of taxa, providing a mechanism for recording and tracking of species status.

In addition to management in the natural habitat, conservation programs leading to viable populations of threatened species may sometimes need a captive component. In general, captive populations and programs can serve several roles in holistic conservation: 1) as genetic and demographic reservoirs that can be used to reinforce wild populations wither by revitalizing populations that are languishing in natural habitats or by re-establishing by translocation populations that have become depleted or extinct; 2) by 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 as well as generate funds for *in situ* conservation.

It is proposed that, when captive populations can assist species conservation, captive and wild populations should, and can be, intensively and interactively managed with interchanges of animals occurring as needed and as feasible. Captive populations should be a support, not a substitute for wild populations. There may be problems with interchange between captive and wild populations with regard 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.

An Overview of the Tapiridae

In comparison with other perissodactyls, the tapir has so far received little attention with regard to its conservation. Perhaps the uncharismatic perception of the tapir has prevented it from receiving the international attention afforded other more "glamorous" large mammals (Barongi, 1993). In view of their threatened and endangered status, this is an alarming reality.

Once widely distributed over many parts of the globe, the modern tapir is confined to the rain forests of Central and South America and Southeast Asia. All but the South American lowland tapir, *Tapirus terrestris,* are in need of immediate attention in the form of field studies and habitat preservation.

The role of herbivores in structuring tropical forests is now beginning to be explored in an active fashion (Eisenberg, Tapir Action Plan, 1993). Tapirs play an important role in dispersing seeds of the fruits upon which they feed (Janzen, 1982).

Only recently have some Central American countries recognized the serious plight of the Baird's tapir and initiated local education programs. We can only hope that the strategy of conserving other flagship species will be applied to the tapir while there is still time to mount an effective conservation program. Currently an IUCN/SSC Tapir Global Action Plan is being developed which will address tapir biology and conservation in greater detail (Matola, pers. comm. 1994).

Threats to Tapiridae

The family Tapiridae consists of one genus and four species. Primarily a tropical rain forest mammal, members of the family are in decline in almost every part of their range. Only the

Brazilian tapir appears to have a secure status in many parts of the range. As with many endangered species, the greatest threat to tapirs is habitat destruction and overhunting (Williams & Petrides, 1980; Janzen, 1983; Fragoso, 1991). Hunting for food is a greater problem in Central and South America than in Asia because of the Muslim belief that the tapir is a type of pig.

The Malayan tapir (T. indicus) is restricted in South Burma, Thailand, the Malay Peninsula, and Sumatra. Approximately 20-35% of the lowland forest in Sumatra was still standing in 1984 (Whitten et al., 1984). In Thailand only 10-13% of the forest cover remained in 1989 (Rabinowitz, 1991).

In Central and South America, habitat loss is much the same. Less than 40% of the original Central American forest remains (Leonard, 1986). Hunting also plays a major role in the decline of Central and South American taxa. Downer (1992) witnessed 30 mountain tapirs poached in Sangay National Park (Ecuador) over a two and one-half year interval. In much of the remaining habitat for the Baird's Tapir (like the Darien in Panama & Colombia and the Peten in Northern Guatemala and western Belize) human colonization has resulted in a decline of the tapir population.

Tapirs are generally an easy species to track and hunt. This is due to their large size, preference for secondary growth as well as agricultural crops, and predictable travel patterns. The mountain tapir is the most critically endangered tapir species, with only a few thousand individuals remaining (Downer, 1992). The Malayan and Baird's tapir are also in urgent need of biologically sound and culturally sensitive conservation programs. If relieved of persecution by local hunters, the tapir will readily adapt to human presence as long as there is adequate habitat.

Taxonomy and Genetics

Taxonomy provides a scientific means to identify groups of animals based on their phenotypic and genotypic differences and similarities. Presently, there are four recognized species in the genus Tapirus: Tapirus terrestris terristris (Linnaeus, 1758), with the subspecies T. t. enigmatus (Gray, 1872), T. t. colombianus (Herskovitz, 1954), and T. t. spegazzine (Ameghino, ____). The three other species are T. (roulini) pinchaque (Roulin, 1829), T. bairdi (Gill, 1865), and T. indicus, with the subspecies T. i. indicus (Demarest, 1819). Chromosomal analysis of tapirs, carried out by O. Ryder, Center for the Reproduction of Endangered Species, Zoological Society of San Diego (USA), reveals the following:

	2n	NF	meta	sub-meta	acro
Tapirus terristris	80	84	--	1	38
Tapirus bairdi	80	98	2	6	31
Tapirus pinchaque	76	84	--	3	34
Tapirus indicus	52	88	4	13	8

evidence to suggest the existence of several subspecies.

The Brazilian or lowland tapir, T. terristris, has the largest range and four historically recognized subspecies. It is very likely that several more subspecies will become evident when more genetic and field research is carried out on this species.

While there is no evidence for the existence of subspecies in T. pinchaque, this species may have the most fragmented populations of any species of Tapirus.

T. bairdi is widely recognized as one species with no subspecies. However, there is historical reference to a separate species of Central American tapir, T. dowi, for Guatemala, Belize, and Nicaragua (Lydekker, 1893). Tissue samples from wild-caught tapirs in Panama are currently being analyzed by CRES, Zoological Society of San Diego (USA).

There is strong evidence of natural hybridization of T. bairdi, T. pinchaque, and T. terrestris in Northern Colombia, northwestern Venezuela, and northern Peru. All these countries are believed to have all three species of New World tapirs with overlapping ranges. As with most secretive rain forest mammals, there is little known about tapir distribution and population densities. A combination of reliable field studies of genetic and blood analysis of wild populations are imperative to shed more light on tapir taxonomy.

The CAMP Process

On 8-12 March, 1994, ten individuals met in San Diego, California to review, refine, and develop further conservation strategies for Tapiridae through conduction of a Conservation Assessment and Management Plan workshop. Participants are listed in Section 5, Appendix I. The CAMP process assembles expertise on wild and captive management for the taxonomic group under review in an intensive and interactive workshop format.

Participants worked together to: 1) determine best estimates of the status of all Tapiridae; 2) assign each taxon to a Mace-Lande and draft IUCN Red List category of threat; and 3) identify areas of action and information needed for conservation and management purposes. Much of this information was presented in the first draft of the 1992 SSC Tapir Action Plan, which was used extensively as a reference during the CAMP process.

The assessments and recommendations of the working group were circulated to the entire group prior to final consensus, as represented in this document. Summary recommendations concerning research management, assignment of all taxa to threatened status, and captive breeding were supported by the workshop participants.

CAMP Workshop Goals

The goals of the Tapir CAMP workshop were:
1) To review the population status and demographic trends for Tapiridae, to test the applicability of the Mace-Lande and the draft IUCN Red List criteria for threat, and to discuss management options for Tapirid taxa.

2) To provide recommendations for *in situ* and *ex situ* management, research and information-gathering for all Tapirid taxa, including: recommendations for Population and Habitat Viability Assessment workshops; more intensive management in the wild; taxonomic research, survey, monitoring, investigation of limiting factors, taxonomy, or other specific research.

3) Produce a discussion draft Conservation Assessment and Management Plan for Tapiridae, presenting the recommendations from the workshop, for distribution to and review by workshop participants and all parties interested in Tapir conservation.

Assignment to Mace-Lande Categories of Threat

All Tapiridae taxa were evaluated on a taxon-by-taxon basis in terms of their current and projected status in the wild to assign priorities for conservation action or information-gathering activities. The workshop participants applied the criteria proposed for the redefinition of the IUCN Red Data Categories proposed by Mace and Lande in their 1991 paper (Section 5, Appendix II). The Mace-Lande scheme assesses threat in terms of a likelihood of extinction within a specified period of time (Table 1). The system defines three categories for threatened taxa:

Critical 50% probability of extinction within five 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.

Definitions of these criteria are based on population viability theory. To assist in making recommendations, participants in the workshop were encouraged to be as quantitative or numerate as possible for two reasons: 1) CAMPs ultimately must establish numerical objectives for viable population sizes and distributions; 2) numbers provide for more objectivity, less ambiguity, more comparability, better communication, and, hence, cooperation. During the workshop, there were many attempts to estimate if the total population of each taxon was greater or less than the numerical thresholds for the three Mace-Lande categories of threat. In many cases, current population estimates for Tapirid taxa were unavailable or available for species/subspecies within a limited part of their distribution. In all cases, conservative numerical estimates were used. **When population numbers were estimated, these estimates represented first-attempt, order-**

<u>of-magnitude educated guesses that were hypotheses for falsification. As such, the workshop participants emphasized that these estimates should not be authoritative for any other purpose than was intended by this process</u>.

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.

Numerical information alone was not sufficient for assignment to one of the Mace-Lande categories of threat. For example, based solely on numbers, a taxon might be assigned to the Vulnerable or Secure category. Knowledge of the current and predicted threats or fragmentation of remaining natural habitat, however, may lead to assignment to a higher category of threat.

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

Mace-Lande categories of threat for the eight taxa examined during this CAMP exercise are presented in Table 2. Tables 9-11 in Section 2 show Mace-Lande and draft IUCN Red List categorization and recommendations for all Tapirid taxa.

Table 2. Threatened Tapirid Taxa - Mace-Lande Categories of Threat.

MACE-LANDE CATEGORY	NUMBER OF TAXA	PERCENT OF TOTAL
Critical	1	14%
Endangered	3	43%
Vulnerable	3	43%
TOTAL	7	100

One of the goals of the CAMP workshop was to test the applicability of the Mace-Lande criteria for threat, which were designed in an attempt to redefine the current IUCN categories of threat.

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 were 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 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, Appendix III in Section 5).

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 the criteria listed in Table 4.

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

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 the criteria listed in Table 4.

CONSERVATION DEPENDENT (CD)
Taxa which do not currently qualify under any of the categories above 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 program which directly affects the taxon in question. 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, or Vulnerable, nor is it Conservation Dependent, but it is of serious concern because of acute restriction in its area of occupancy (typically < 100 km^2) or in the number of locations (typically <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 Critical or even Extinct in a very short period.

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.

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 3. DRAFT IUCN RED LIST CATEGORIES - FEBRUARY 1994

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 km² or area of occupancy est. < 10 km², AND TWO of the following:	Est. < 5,000 km² or area of occupancy est. < 500 km², AND TWO of the following:	Est. < 20,000 km² or area of occupancy est. < 2,000 km², 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

New IUCN Red List categories for the seven taxa examined during this CAMP exercise taxa are presented in Table 4. Specific taxa within each Mace-Lande and draft IUCN Red List category are presented in Tables 8-10 in Section 2.

Table 4. Threatened Tapirid Taxa - New IUCN Red List Categories of Threat.

NEW IUCN RED LIST CATEGORY	NUMBER OF TAXA	PERCENT OF TOTAL
Extinct	0	0
Extinct in Wild	0	0
Critical	1	14
Endangered	3	43
Vulnerable	1	14
Susceptible	0	0
Conservation Dependent	2	29
Low Risk	0	0
Data Deficient	0	0
Not Evaluated	0	0
TOTAL	7	100

Regional Distribution of Threatened Taxa

Regional distribution of threatened taxa is presented in Table 5. Six threatened Tapirid taxa are found in Central and South America and one in Southeast Asia.

Table 5. Regional distribution of threatened Tapirid taxa.

MACE-LANDE	REGION	
	C & S AMERICA	SOUTHEAST ASIA
Critical	1	0
Endangered	2	1
Vulnerable	3	0
TOTAL	6	1

Recommendations for Intensive Management and Research Actions

For all taxa, recommendations were generated for the kinds of intensive action necessary, both in terms of management and research, that were felt to be necessary for conservation. These recommendations, summarized in Table 6, were: Population and Habitat Viability Assessment (PHVA) workshops; wild management and research; and captive programs. PHVA workshops provide a means of assembling available detailed biological information on the respective taxa, evaluating the threats to their habitat, development of management scenarios with immediate and 100-year time-scales, and the formulation of specific adaptive management plans with the aid of simulation models. In many cases, workshop participants determined that the current level of information for a taxa was not adequate for conduction of a PHVA; in those cases, recommendations are listed as "PHVA Pending."

Workshop participants attempted to develop an integrated approach to management and research actions needed for the conservation of Tapirid taxa. In all cases, an attempt was made to make management and research recommendations based on the various levels of threat impinging on the taxa. For the purposes of the CAMP process, threats were defined as "immediate or predicted events that are or may cause significant population declines."

With only partial understanding of underlying causes for decline in some taxa, it was sometimes difficult to clearly define specific management actions needed for the conservation. Therefore, "research management" must become a component of conservation and recovery activities.

Research management can be defined as a management program which includes a strong feedback between management activities and an evaluation of the efficacy of the management, as well as response of the Tapirid taxa to that activity. Seven basic categories of research management activities were identified: survey (e.g., search and find); monitoring; translocation; taxonomic research or clarification; management of limiting factors; limiting factors research; and life history research. The frequent need for survey information to evaluate population status, especially for those taxa listed as Critical, emphasizes the need to quickly implement intensive survey methodologies. Research management recommendations are summarized in Table 6.

Table 6. Research management recommendations for Tapirids.

MACE-LANDE	PHVA	PHVA PEND	SURV	MONITR	LIFE HISTORY RESRCH	LIMITING FACTORS RESRCH	LIMITING FACTORS MGMT	HABITAT MGMT	TAXON RESRCH	TRNS LOC
Critical	1	0	1	1	0	0	1	1	1	1
Endangered	2	2	2	3	0	0	0	3	3	1
Vulnerable	2	0	0	1	0	0	0	3	3	0
TOTAL	5	2	3	5	0	0	1	7	7	2

Captive Program Recommendations

For a few of the Tapiridae taxa, it was determined that a captive component would be necessary to contribute to the maintenance of long-term viable populations. It is proposed that, when captive populations can assist species conservation, captive and wild populations should be intensively and interactively managed with interchanges of animals occurring as needed and as feasible. There may be problems with interchange between captive and wild populations with regard to disease, logistics, and financial limitations. Today, as more and more species are threatened with population declines, cooperative recovery programs, including both zoos and the private sector, may provide a major avenue for survival. This cooperation must include support for field research, habitat conservation, as well as public education.

When *ex situ* management was recommended, the "level" of captive program was also prepared, reflecting status, prospects in the wild, and taxonomic distinctiveness. The captive levels used during the Tapirid CAMP 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.

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.

Other captive recommendations include:

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 shod 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 PHVA, a survey, or existing identified sources to be queried.

During the CAMP workshop, all Tapirid taxa were evaluated relative to their current need for captive propagation. Recommendations were based upon a number of variables, including: immediate need for conservation (population size, Mace-Lande status, population trend, type of captive propagation program), need for or suitability as a surrogate species, current captive populations, and determination of difficulty as mentioned above. Based on all of the above considerations, in addition to threats, trends, Mace-Lande and draft IUCN Red List assessment, recommendations for captive programs were made. These recommendations, by category of threat, are presented in Table 7. Recommendations for levels of programs are presented in the spreadsheet in Section 2.

Table 7. Captive program recommendations for Tapirids by Mace-Lande threat category.

MACE-LANDE	Level 1	Level 2	Pending	No
Critical	1	0	0	0
Endangered	2	0	1	0
Vulnerable	0	0	2	1
TOTAL	3	0	3	1

The participants in the Tapir CAMP meeting wish to emphasize that we do not view any of the recommendations of this document as "stand-alone" initiatives. Rather, the reader is encouraged to see these activities as components of the overall need for the conservation of tropical ecosystems. The Tapiridae are excellent candidates (as bio-indicators, key species or flagships) to help facilitate larger-scale conservation programs. We therefore urge their inclusion in the planning stages of projects related to research, monitoring and management of tropical rainforests, protected areas and other natural ecosystems.

TAPIR

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SECTION 2

SPREADSHEET CATEGORY DEFINITIONS
AND SPREADSHEET FOR ALL TAPIRID TAXA

CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP) SPREADSHEET CATEGORIES

The Conservation Assessment and Management Plan (CAMP) spreadsheet is a working document that provides information that can be used to assess the 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
SCIENTIFIC NAME: Scientific names of extant taxa: genus, species, subspecies.

WILD POPULATION
RANGE: Geographical area where a species and its subspecies occur.

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

DQ (Data Quality):

1 = Recent (<8 years) census or population monitoring
2 = Recent (<8 years) general field study
3 = Recent (<8 years) anecdotal field sightings
4 = Indirect information (trade numbers, habitat availability).

Any combination of above = different data quality in parts of range.

SUB-POP: Number of populations within the taxonomic unit. Ideally, the number of populations is described in terms of boundary conditions as delineated by Mace-Lande and indicates the degree of fragmentation. If a population is fragmented, an "F" may be entered.

TRND: Indicates whether the natural trend of the species/subspecies/population is currently (over the past 3 generations) increasing (I), decreasing (D), or stable (S). Note that trends should NOT reflect supplementation of wild populations. A + or - may be indicated to indicate a rapid or slow rate of change, respectively.

AREA: A quantification of a species' geographic distribution.

AAA: > 5,000 sq km; geographic island
AA: < 5,000 sq km; geographic island
AA-1: < 1,000 sq km; geographic island

AA-2: < 100 sq km; geographic island
AA-3: < 10 sq km; geographic island
A: < 5,000 sq km
B: 5,000 - 9,999 sq km
C: 10,000 - 49,999 sq km
D: 50,000 - 99,999 sq km
E: > 100,000 sq km
F: 500,000 - 999,999 sq km
G: > 1,000,000 sq km

M/L STS: Status according to Mace/Lande criteria.
C = Critical
E = Endangered
V = Vulnerable
S = Secure
EXT = Extinct

IUCN: Status according to Draft IUCN Red List criteria.
CR = Critical
EN = Endangered
VU = Vulnerable
CD = Conservation Dependent
SU = Susceptible
LR = Low Risk
DD = Data Deficient
NE = Not Evaluated

THREATS: Immediate or predicted events that are or may cause significant population declines.
A = Aircraft
C = Climate
D = Disease
F = Fishing
G = Genetic problems
Hf = Hunting for food
Ht = Hunting for trophies
Hyb = Hybridization
I = Human interference or disturbance
Ic = Interspecific competition
Ice = Interspecific competition from exotics
Il = Interspecific competition with domestic livestock
L = Loss of habitat

La = Loss of habitat because of exotic animals
Lf = Loss of habitat because of fragmentation
Lp = Loss of habitat because of exotic plants
M = Marine perturbations, including ENSO and other shifts
P = Predation
Pe = Predation by exotics
Ps= Pesticides
Pl= Powerlines
Po= Poisoning
Pu= Pollution
S = Catastrophic events
    Sd: drought
    Sf: fire
    Sh: hurricane
    St: tsunami
    Sv: volcano
T = Trade for the life animal market
W = War

PHVA: Is a Population and Habitat Viability Assessment Workshop recommended? Yes or No? NOTE**A detailed model of a species' biology is frequently not needed to make sound management decisions. Yes or No/Pending: pending further data from surveys or other research.

Research/Management:
It should be noted that there is (or should be) a clear relationship between threats and subsequent outlined research/management actions. The "Research/Management" column provides an integrated view of actions to be taken, based on the listed threats. Research management can be defined as a management program which includes a strong feedback between management activities and an evaluation of the efficacy of the management, as well as response of the bird species to that activity. The categories within the column are as follows:

T	=	Taxonomic and morphological genetic studies
Tl	=	Translocations
S	=	Survey - search and find
M	=	Monitoring - to determine population information
H	=	Husbandry research
Hm	=	Habitat management - management actions primarily intended to protect and/or enhance the species' habitat (e.g., forest management)
Lm	=	Limiting factor management - "research management" activities on known or suspected limiting factors. Management projects have a research component that provide scientifically defensible results.

Lr = Limiting factor research - research projects aimed at determining limiting factors. Results from this work may provide management recommendations and future research needs.

Lh = Life history studies

CAPTIVE PROGRAMS

NUM: Number of individuals in captivity (according to ISIS and other information, when available).

DIFF: This column represents the level of difficulty in maintaining the species in captive conditions.

1 = **Least difficult.** Techniques are in place for capture, maintenance, and propagation of similar taxa in captivity, which ostensibly could be applied to the taxon.

2 = **Moderate difficulty.** Techniques are only partially in place for capture, maintenance, and propagation of similar taxa in captivity, and many captive techniques still need refinement.

3 = **Very difficult.** Techniques are not in place for capture, maintenance, and propagation of similar taxa in captivity, and captive techniques still need to be developed.

REC: 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 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.

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.

Other captive recommendations include:

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 shod 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 PHVA, a survey, or existing identified sources to be queried.

Table 8. Spreadsheet for Critical and Endangered taxa according to Mace-Lande criteria.

	TAXON		WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME		RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L	NEW IUCN	THRTS	PVA/ WKSP	RSCH MGMT	DIFF	REC	NUM
	Perissodactyla															
	Tapiridae															
1	Tapirus	terrestris												1	N	<250
3	Tapirus	terrestris enigmaticus	S Ecuador & NE Peru	<500 >200	4	Yes	D	C	E	EN	H,I,L,Lf	Yes	T,H, Hm	1	P	<5
6	Tapirus	pinchaque	Andes from NW Venezuela to NW Peru	<1000 >200	2,3,4	<25 >10	D+	AAA	C	CR	H,I,L,Lf Pu	Yes	T,TI,S, M,Hm, Lm	1	1	<10
7	Tapirus	bairdi	S Mexico to Colombia, Venezuela	<6300 >2500	3,4	Yes	D	F	E	EN	L,I,Lf,H	Yes	T,TI,S, M,Hm	1	1	<60
8	Tapirus	indicus	S Burma & Thailand, Malay Peninsula & Sumatra	<3000 >900	4	Yes	D	F	E	EN	L,I,Lf	Pend	T,S,M, Hm	1	1	<210

Table 9. Spreadsheet for Vulnerable taxa according to Mace-Lande criteria

	TAXON		WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME		RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L	NEW IUCN	THRTS	PVA/ WKSP	RSCH MGMT	DIFF	REC	NUM
	Perissodactyla															
	Tapiridae															
1	Tapirus	terrestris												1	N	<250
2	Tapirus	terrestris terrestris	Colombia & Venezuela to Bolivia & S Brazil	<30000 >18000	3,4	Yes	D	G	V	CD	H,I,L,Lf	No	T,M, Hm	1	N	<20
4	Tapirus	terrestris colombianus	Northwest Colombia	<1000 >200	4	Yes	D	C	V	CD	H,I,L,Lf	Yes/ Pend	T,H, Hm	1	P	<5
5	Tapirus	terrestris spegazzini	South Bolivia, Paraguay to Northern Argentina	<1000 >200	3,4	Yes	D	D	V	VU	H,I,L,Lf	Yes/ Pend	T,H, Hm	1	P	<5

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Table 10. Spreadsheet for All Tapirid Taxa.

	TAXON		WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME		RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L	NEW IUCN	THRTS	PVA/ WKSP	RSCH MGMT	DIFF	REC	NUM
	Perissodactyla															
	Tapiridae															
1	Tapirus	terrestris												1	N	<250
2	Tapirus	terrestris terrestris	Colombia & Venezuela to Bolivia & S Brazil	<30000 >18000	3,4	Yes	D	G	V	CD	H,I,L,Lf	No	T,M, Hm	1	N	<20
3	Tapirus	terrestris enigmaticus	S Ecuador & NE Peru	<500 >200	4	Yes	D	C	E	EN	H,I,L,Lf	Yes	T,H, Hm	1	P	<5
4	Tapirus	terrestris colombianus	North-west Colombia	<1000 >200	4	Yes	D	C	V	CD	H,I,L,Lf	Yes/ Pend	T,H, Hm	1	P	<5
5	Tapirus	terrestris spegazzini	South Bolivia, Paraguay to Northern Argentina	<1000 >200	3,4	Yes	D	D	V	VU	H,I,L,Lf	Yes/ Pend	T,H, Hm	1	P	<5
6	Tapirus	pinchaque	The Andes from NW Venezuela to NW Peru	<1000 >200	2,3 ,4	<25 >10	D+	AAA	C	CR	H,I,L,Lf Pu	Yes	T,Tl,S, M,Hm,Lm	1	1	<10
7	Tapirus	bairdi	S Mexico to Colombia,Venezuela	<6300 >2500	3,4	Yes	D	F	E	EN	L,I,Lf,H	Yes	T,Tl,S, M,Hm	1	1	<60
8	Tapirus	indicus	S Burma & Thailand, Malay Peninsula & Sumatra	<3000 >900	4	Yes	D	F	E	EN	L,I,Lf	Pend	T,S,M, Hm	1	1	<210

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SECTION 3

TAXON DATA SHEETS FOR ALL TAXA

CAMP TAXON REPORT

SPECIES: *Tapirus pinchaque*

STATUS:

Mace-Lande: Critical
CITES: Appendix I
IUCN: Endangered
New Red List: Critical

Taxonomic status: One species, no recognized subspecies

Distribution: The Andes from N.W. Venezuela to N.W. Peru

Wild Population: 200-1,000 in four countries

Field Studies: Schauenberg (1969), Downer (1992)

Threats: Habitat loss, hunting for food, fragmentation of habitat, pollution

Comments: Surveys are needed to determine the exact status of this species. Where surveys have been completed, monitoring of the species should take place. Fragmentation of habitat is certainly effecting this species and the population appears to be declining. Population estimates in this document are based on a best guess.

Recommendations:

Research management: Surveys, monitoring, habitat management
PHVA: Yes

Captive Population: > 10 in North America; a single female in Europe.

Captive Program Recommendation: Currently there are 6.2 in North America. One male in Los Angeles is not reproductive. Without the addition of new founders, this captive program cannot continue. There is currently a need to translate tapir husbandry and veterinary care from English to Spanish.

CAMP TAXON REPORT

SPECIES: *Tapirus bairdi*

STATUS:

Mace-Lande: Endangered
CITES: Appendix I
IUCN: Endangered
New Red List: Endangered

Taxonomic status: One species; no recognized subspecies

Distribution: S. Mexico to Colombia, Venezuela

Wild Population: 2,500-6,300

Field Studies: Costa Rica (Williams), Belize (Fragoso), Panama (Terwilliger)

Threats: Loss of habitat, human interference or disturbance, hunting for food or other purposes, loss of habitat because of fragmentation

Comments: More than half of *T. bairdi's* geographical range has been destroyed over the last 40 years. A PHVA was conducted in Panama by CBSG in November 1994. The population estimate in this document is based upon exisisting suitable habitat.

Recommendations:

Wild management: Field studies status needed: Honduras, Nicaragua, Panama, Northern Colombia and Venezuela
Research: Address question about possible interbreeding with *T. terrestris*. Investigate possibilities for future reintroduction.
Research management: Taxonomy, Translocation, Survey, Monitoring, and Habitat Management
PHVA: Yes

Captive Population: < 60 in 20 locations

Captive Program Recommendation: Level 2; current stock will require the addition of new founders to meet program goals. Develop pregnancy detection methods to better anticipate parturition and decrease neonatal mortality. There is currently a need to translate tapir husbandry and veterinary care from English to Spanish.

CAMP TAXON REPORT

SPECIES: *Tapirus indicus*

STATUS:

Mace-Lande: Endangered
CITES: Appendix I
IUCN: Endangered
New Red List: Endangered

Taxonomic status: One species; no recognized subspecies

Distribution: S. Burma, Malaysia, Thailand, Cambodia, Sumatra

Wild Population: 900 - 3,000

Field Studies: Williams, K. D. (1979). Radio Tracking Tapirs in the Primary Rain Forest of West Malaysia, Malayan Nature Journal, vol. 32, Nos. 3&4: 253-258.

Threats: Clear cutting of forests

Comments: More field data needed, governmental protection enforced. The population estimates in this document are based on a best guess.

Recommendations:

Wild management: Field studies in Malaysia, Burma and Thailand needed. Taxonomic analysis between mainland and Sumatran tapirs is needed.
Research: Perfect telemetry equipment for field studies and future translocation.
Research Management: Taxonomy, Survey, Habitat Management, Monitoring, Translocation (Sumatran subspp.), and Monitoring (S. Burma, Thailand, and Malay peninsula)
PHVA: Yes, in Malaysia, Burma, Thailand and Sumatra

Captive Population: < 210 animals in 58 locations

Captive Program Recommendation: Level 1; current stock is sufficient to meet program goals without the need to add new founder stock at this time. Develop pregnancy detection methods to better anticipate parturition and decrease neonatal mortality.

CAMP TAXON REPORT

SPECIES: *Tapirus terrestris*

STATUS:

Mace-Lande: Endangered (*T.t. enigmaticus*) Vulnerable (*T.t. terrestris*, *T.t. colombianus*, and *T.t. spegazzini*)
CITES: Appendix II
IUCN: Vulnerable
New Red List: Conservation Dependent (*T.t. terrestris* and *T.t. columbianus*); Endangered (*T.t. enigmaticus*); Vulnerable (*T.t. spegazzini*)

Taxonomic status: Four subspecies

Distribution: S. America from Colombia and Venezuela to N. Argentina and S. Brazil

Wild Population: 18,000-30,000

Field Studies: Brooks, Chalukian, Fragoso, Salas (ref from Don Jansen)

Threats: Hunting for food, human interference, loss of habitat, habitat fragmentation

Comments: Baseline data is greatly needed as population estimates are purely best guess.

Recommendations:

Wild management: Control illegal hunting, develop sustainable harvest with indigenous tribes, insure reserves of sufficient size for sustainable populations
Research: Population updates, genetic research to justify subspeciation; study of areas, populations, and genetics where *T. terrestris* and *T. bairdi* ranges overlap because of possible hybridization
Research management: Taxonomy, Survey, Monitoring, and Habitat Management
PHVA: Pending, if demographic studies identify a need.

Captive Population: < 200

Captive Program Recommendation: Because subspecific classification in the vast majority of the terrestris held in captivity is undetermined, and there exist more urgent needs for the other three species, we are recommending this captive population be reduced to no more than 100 specimens. Development of effective contraception is needed to facilitate this mgt. strategy. There is currently a need to translate tapir husbandry and veterinary care from English to Spanish.

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SECTION 4

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SECTION 5

APPENDICES

APPENDIX I.

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Essay

Assessing Extinction Threats: Toward a Reevaluation of IUCN Threatened Species Categories

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Abstract: *IUCN categories of threat (Endangered, Vulnerable, Rare, Indeterminate, and others) are widely used in 'Red lists' of endangered species and have become an important tool in conservation action at international, national, regional, and thematic levels. The existing definitions are largely subjective, and as a result, categorizations made by different authorities differ and may not accurately reflect actual extinction risks. We present proposals to redefine categories in terms of the probability of extinction within a specific time period, based on the theory of extinction times for single populations and on meaningful time scales for conservation action. Three categories are proposed (CRITICAL, ENDANGERED, VULNERABLE) with decreasing levels of threat over increasing time scales for species estimated to have at least a 10% probability of extinction within 100 years. The process of assigning species to categories may need to vary among different taxonomic groups, but we present some simple qualitative criteria based on population biology theory, which we suggest are appropriate at least for most large vertebrates. The process of assessing threat is clearly distinguished from that of setting priorities for conservation action, and only the former is discussed here.*

Resumen: *La categorización de la Unión Internacional para la Conservación de la Naturaleza (UICN) de las especies amenazadas (en peligro, vulnerables, raras, indeterminadas y otras) son ampliamente utilizadas en las Listas Rojas de especies en peligro y se han convertido en una herramienta importante para las acciones de conservación al nivel internacional, nacional, regional y temático. Las definiciones de las categorías existentes son muy subjetivas y, como resultado, las categorizaciones hechas por diferentes autores difieren y quizás no reflejen con certeza el riesgo real de extinción. Presentamos propuestas para re-definir las categorías en términos de la probabilidad de extinción dentro de un período de tiempo específico. Las propuestas están basadas en la teoría del tiempo de extinción para poblaciones individuales y en escalas de tiempo que tengan significado para las acciones de conservación. Se proponen tres categorías (CRITICA, EN PELIGRO, VULNERABLE) con niveles decrecientes de amenaza sobre escalas de tiempo en aumento para especies que se estima tengan cuando ménos un 10% de probabilidad de extinción en 100 años. El proceso de asignar especies a categorías puede que necesite variar dentro de los diferentes grupos taxonómicos pero nosotros presentamos algunos criterios cualitativos simples basados en la teoría de la biología de las poblaciones, las cuales sugerimos son apropiadas para cuando ménos la mayoría de los grandes vertebrados. El proceso de evaluar la amenaza se distingue claramente del de definir las prioridades para las acciones de conservación, sólamente el primero se discute aquí.*

Paper submitted February 12, 1990; revised manuscript accepted October 8, 1990.

Introduction

Background

The Steering Committee of the Species Survival Commission (SSC) of the IUCN has initiated a review of the overall functioning of the Red Data Books. The review will cover three elements: (1) the form, format, content, and publication of Red Data Books; (2) the categories of threat used in Red Data Books and the IUCN Red List (Extinct, Endangered, Vulnerable, Rare, and Indeterminate); and (3) the system for assigning species to categories. This paper is concerned with the second element and includes proposals to improve the objectivity and scientific basis for the threatened species categories currently used in Red Data Books (see IUCN 1988 for current definitions).

There are at least three reasons why a review of the categorization system is now appropriate: (1) the existing system is somewhat circular in nature and excessively subjective. When practiced by a few people who are experienced with its use in a variety of contexts it can be a robust and workable system, but increasingly, different groups with particular regional or taxonomic interests are using the Red Data Book format to develop local or specific publications. Although this is generally of great benefit, the interpretation and use of the present threatened species categories are now diverging widely. This leads to disputes and uncertainties over particular species that are not easily resolved and that ultimately may negatively affect species conservation. (2) Increasingly, the categories of threat are being used in setting priorities for action, for example, through specialist group action plans (e.g., Oates 1986; Eudey 1988; East 1988, 1989; Schreiber et al. 1989). If the categories are to be used for planning then it is essential that the system used to establish the level of threat be consistent and clearly understood, which at present it does not seem to be. (3) A variety of recent developments in the study of population viability have resulted in techniques that can be helpful in assessing extinction risks.

Assessing Threats Versus Setting Priorities

In the first place it is important to distinguish systems for assessing threats of extinction from systems designed to help set priorities for action. The categories of threat should simply provide an assessment of the likelihood that if current circumstances prevail the species will go extinct within a given period of time. This should be a scientific assessment, which ideally should be completely objective. In contrast, a system for setting priorities for action will include the likelihood of extinction, but will also embrace numerous other factors, such as the likelihood that restorative action will be successful; economic, political, and logistical considerations; and perhaps the taxonomic distinctiveness of the species under review. Various categorization systems used in the past, and proposed more recently, have confounded these two processes (see Fitter & Fitter 1987; Munton 1987). To devise a general system for setting priorities is not useful because different concerns predominate within different taxonomic, ecological, geographical, and political units. The process of setting priorities is therefore best left to specific plans developed by specialist bodies such as the national and international agencies, the specialist groups, and other regional bodies that can devise priority assessments in the appropriate regional or taxonomic context. An objective assessment of extinction risk may also then contribute to the decisions taken by governments on which among a variety of recommendations to implement. The present paper is therefore confined to a discussion of assessing threats.

Aims of the System of Categorization

For Whom?

Holt (1987) identifies three different groups whose needs from Red Data Books (and therefore categories of threat) may not be mutually compatible: the lay public, national and international legislators, and conservation professionals. In each case the purpose is to highlight taxa with a high extinction risk, but there are differences in the quality and quantity of information needed to support the assessment. Scott et al. (1987) make the point that in many cases simple inclusion in a Red Data Book has had as much effect on raising awareness as any of the supporting data (see also Fitter 1974). Legislators need a simple, but objective and soundly based system because this is most easily incorporated into legislation (Bean 1987). Legislators frequently require some statement about status for every case they consider, however weak the available information might be. Inevitably, therefore, there is a conflict between expediency and the desire for scientific credibility and objectivity. Conservationists generally require more precision, particularly if they are involved in planning conservation programs that aim to make maximal use of limited resources.

Characteristics of an Ideal System

With this multiplicity of purposes in mind it is appropriate to consider various characteristics of an ideal system:

(1) The system should be essentially simple, providing easily assimilated data on the risk of extinction. In terms of assessing risk, there seems to be little virtue in developing numerous categories, or in categorizing risk on the basis of a range of different parameters (e.g., abundance, nature of threat, likelihood of persistence of threat, etc.). The categories should be few in number,

should have a clear relationship to one another (Holt 1987; Munton 1987), and should be based around a probabilistic assessment of extinction risk.

(2) The system for categorization has to be flexible in terms of data required. The nature and amount of data available to assess extinction risks varies widely from almost none (in the vast majority of species) to highly detailed population data (in a very few cases). The categorization system should make maximum use of whatever data are available. One beneficial consequence of this process would be to identify key population data for field workers to collect that would be useful in assessing extinction risk.

(3) The categorization system also needs to be flexible in terms of the population unit to which it applies. Throughout this discussion, it is assumed that the system being developed will apply to any species, subspecies, or geographically separate population. The categorization system therefore needs to be equally applicable to limited lower taxonomic levels and to more limited geographical scope. Action planning will need to be focused on particular taxonomic groups or geographical areas, and can then incorporate an additional system for setting priorities that reflect taxonomic distinctiveness and extinction risks outside the local area (e.g., see East 1988, 1989; Schreiber et al. 1989).

(4) The terminology used in categorization should be appropriate, and the various terms used should have a clear relationship to each other. For example, among the current terms both 'endangered' and 'vulnerable' are readily comprehended, but 'rare' is confusing. It can be interpreted as a statement about distribution status, level of threat, or local population size, and the relationships between these factors are complex (Rabinowitz et al. 1986). Rare (i.e., low-density) species are not always at risk and many species at risk are not numerically rare (King 1987; Munton 1987; Heywood 1988). The relationship of 'rare' to 'endangered' and 'vulnerable' is also unclear.

(5) If the system is to be objectively based upon sound scientific principles, it should include some assessment of uncertainty. This might be in terms of confidence levels, sensitivity analyses, or, most simply, on an ordinal scale reflecting the adequacy of the data and models in any particular case.

(6) The categories should incorporate a time scale. On a geological time scale all species are doomed to extinction, so terms such as "in danger of extinction" are rather meaningless. The concern we are addressing here is the high background level of the current rates of extinction, and one aim is therefore preservation over the upcoming centuries (Soulé & Simberloff 1986). Therefore, the probability of extinction should be expressed in terms of a finite time scale, for example, 100 years. Munton (1987) suggests using a measure of number of years until extinction. However, since most models of population extinction times result in approximately exponential distributions, as in Goodman's (1987) model of density-dependent population growth in a fluctuating environment, mean extinction time may not accurately reflect the high probability that the species will go extinct within a time period considerably shorter than the mean (see Fig. 1). More useful are measures such as "95% likelihood of persistence for 100 years."

Population Viability Analysis and Extinction Factors

Various approaches to defining viable populations have been taken recently (Shaffer 1981, 1990; Gilpin & Soulé, 1986; Soulé 1987). These have emphasized that there is no simple solution to the question of what constitutes a viable population. Rather, through an analysis of extinction factors and their interactions it is possible to assess probabilities and time scales for population persistence for a particular taxon at a particular time and place. The development of population viability analyses has led to the definition of intrinsic and extrinsic factors that determine extinction risks (see Soulé 1983; Soulé 1987; Gilpin & Soulé 1986; see also King 1987). Briefly these can be summarized as population dynamics (number of individuals, life history and age or stage distribution, geographic structure, growth rate, variation in demographic parameters), population characteristics (morphology, physiology, genetic variation, behavior and dispersal patterns), and environmental effects (habitat quality and quantity, patterns and rates of environmental disturbance and change, interactions with other species including man).

Preliminary models are available to assess a population's expected persistence under various extinction pressures, for example, demographic variation (Goodman 1987*a, b;* Belovsky 1987; CBSG 1989), catastrophes (Shaffer 1987), inbreeding and loss of genetic diversity (Lande & Barrowclough 1987; Lacy 1987), metapopulation structure (Gilpin 1987; Quinn & Hastings 1987; Murphy et al. 1990). In addition, various approaches have been made to modeling extinction in populations threatened by habitat loss (e.g., Gutiérrez & Carey 1985; Maguire et al. 1987; Lande 1988), disease (e.g., Anderson & May 1979; Dobson & May 1986; Seal et al. 1989), parasites (e.g., May & Anderson 1979; May & Robinson 1985; Dobson & May 1986), competitors, poaching (e.g., Caughley 1988), and harvesting or hunting (e.g., Holt 1987).

So far, the development of these models has been rather limited, and in particular they often fail to successfully incorporate several different extinction factors and their interactions (Lande 1988). Nevertheless the approach has been applied in particular cases even with existing models (e.g., grizzly bear: Shaffer 1983; spotted owl: Gutiérrez & Carey 1985; Florida panther: CBSG 1989), and there is much potential for further development.

Although different extinction factors may be critical for different species, other, noncritical factors cannot be ignored. For example, it seems likely that for many species, habitat loss constitutes the most immediate threat. However, simply preserving habitats may not be sufficient to permit long term persistence if surviving populations are small and subdivided and therefore have a high probability of extinction from demographic or genetic causes. Extinction factors may also have cumulative or synergistic effects; for example, the hunting of a species may not have been a problem before the population was fragmented by habitat loss. In every case, therefore, all the various extinction factors and their interactions need to be considered. To this end more attention needs to be directed toward development of models that reflect the random influences that are significant to most populations, that incorporate the effects of many different factors, and that relate to the many plant, invertebrate, and lower vertebrate species whose population biology has only rarely been considered so far by these methods.

Viability analysis should suggest the appropriate kind of data for assigning extinction risks to species, though much additional effort will be needed to develop appropriate models and collect appropriate field data.

Proposal

Three Categories and Their Justification

We propose the recognition of three categories of threat (plus EXTINCT), defined as follows:

CRITICAL:	50% probability of extinction within 5 years or 2 generations, whichever is longer.
ENDANGERED:	20% probability of extinction within 20 years or 10 generations, whichever is longer.
VULNERABLE:	10% probability of extinction within 100 years.

These definitions are based on a consideration of the theory of extinction times for single populations as well as on meaningful time scales for conservation action. If biological diversity is to be maintained for the foreseeable future at anywhere near recent levels occurring in natural ecosystems, fairly stringent criteria must be adopted for the lowest level of extinction risk, which we call VULNERABLE. A 10% probability of extinction within 100 years has been suggested as the highest level of risk that is biologically acceptable (Shaffer 1981) and seems appropriate for this category. Furthermore, events more than about 100 years in the future are hard to foresee, and this may be the longest duration that legislative systems are capable of dealing with effectively.

It seems desirable to establish a CRITICAL category to emphasize that some species or populations have a very high risk of extinction in the immediate future. We propose that this category include species or populations with a 50% chance of extinction within 5 years or two generations, and which are clearly at very high risk.

An intermediate category, ENDANGERED, seems desirable to focus attention on species or populations that are in substantial danger of extinction within our lifetimes. A 20% chance of extinction within 20 years or 10 generations seems to be appropriate in this context.

For increasing levels of risk represented by the categories VULNERABLE, ENDANGERED, and CRITICAL, it is necessary to increase the probability of extinction or to decrease the time scale, or both. We have chosen to do both for the following reasons. First, as already mentioned, decreasing the time scale emphasizes the immediacy of the situation. Ideally, the time scale should be expressed in natural biological units of generation time of the species or population (Leslie 1966), but there is also a natural time scale for human activities such as conservation efforts, so we have given time scales in years and in generations for the CRITICAL and ENDANGERED categories.

Second, the uncertainty of estimates of extinction probabilities decreases with increasing risk levels. In population models incorporating fluctuating environments and catastrophes, the probability distribution of extinction times is approximately exponential (Nobile et al. 1985; Goodman 1987). In a fluctuating environment where a population can become extinct only through a series of unfavorable events, there is an initial, relatively brief period in which the chance of extinction is near zero, as in the inverse Gaussian distribution of extinction times for density-independent fluctuations (Ginzburg et al. 1982; Lande & Orzack 1988). If catastrophes that can extinguish the population occur with probability p per unit time, and are much more important than normal environmental fluctuations, the probability distribution of extinction times is approximately exponential, pe^{-pt}, and the cumulative probability of extinction up to time t is approximately $1 - e^{-pt}$. Thus, typical probability distributions of extinction times look like the curves in Figures 1A and 1B, and the cumulative probabilities of extinction up to any given time look like the curves in Figures 1C and 1D. Dashed curves represent different distributions of extinction times and cumulative extinction probabilities obtained by changing the model parameters in a formal population viability analysis (e.g., different amounts of environmental variation in demographic parameters). The uncertainty in an estimate of cumulative extinction probability up to a certain time can be measured by its coefficient of variation, that is, the standard deviation among different estimates of the cumulative extinction probability with respect to reasonable variation in model parameters, divided by the best estimate. It is apparent from Figures 1C and 1D that at least for small variations in the parameters (if the parameters are reasonably well known), the uncertainty of estimates of cumulative extinction probability at particular times decreases as the level of risk increases. Thus at times, t_1, t_2, and t_3 when the best estimates of the cumulative extinction probabilities are 10%, 20%, and 50% respectively, the corresponding ranges of extinction probabilities in Figure 1C are 6.5%–14.8%, 13.2%–28.6%, and 35.1%–65.0%, and in Figure 1D are 6.8%–13.1%, 13.9%–25.7%, and 37.2%–60.2%. Taking half the range as a rough approximation of the standard deviation in this simple illustration gives uncertainty measures of 0.41, 0.38, and 0.30 in Figure 1C, and 0.31, 0.29, and 0.23 in Figure 1D, corresponding to the three levels of risk. Given that for practical reasons we have chosen to shorten the time scales for the more threatened categories, these results suggest that to maintain low levels of uncertainty, we should also increase the probabilities of extinction in the definition of the ENDANGERED and CRITICAL categories.

These definitions are based on general principles of population biology with broad applicability, and we believe them to be appropriate across a wide range of life forms. Although we expect the process of assigning species to categories (see below) to be an evolving (though closely controlled and monitored) process, and one that might vary across broad taxonomic groups, we recommend that the definitions be constant both across taxonomic groups and over time.

Assigning Species or Populations to Categories

We recognize that in most cases, there are insufficient data and imperfect models on which to base a formal probabilistic analysis. Even when considerable information does exist there may be substantial uncertainties in the extinction risks obtained from population models containing many parameters that are difficult to estimate accurately. Parameters such as environmental stochasticity (temporal fluctuations in demographic parameters such as age- or developmental stage–specific mortality and fertility rates), rare catastrophic events, as well as inbreeding depression and genetic variability in particular characters required for adaptation are all difficult to estimate accurately. Therefore it may not be possible to do an accurate probabilistic viability analysis even for some very well studied species. We suggest that the categorization of many species should be based on more qualitative criteria derived from the same body of theory as the definitions above, which will broaden the scope and applicability of the categorization system. In these more qualitative criteria we use measures of effective population size (N_e) and give approximate equivalents in actual population size (N). It is important to recognize that the relationship between N_e and N depends upon a variety of interacting factors. Estimating N_e for a particular population will require quite extensive information on breeding structure and life history characteristics of the population and may then produce only an approximate figure (Lande & Barrowclough 1987). In addition, different methods of estimating N_e will give variable results (Harris & Allendorf 1989). N_e/N ratios vary widely across species, but are typically in the range 0.2 to 0.5. In the criteria below we give a value for N_e as well as an approximate value of N assuming that the N_e/N ratio is 0.2.

We suggest the following criteria for the three categories:

CRITICAL: 50% probability of extinction within 5 years or 2 generations, whichever is longer, or

(1) Any two of the following criteria:

(a) Total population $N_e < 50$ (corresponding to actual $N < 250$).

(b) Population fragmented: ≤ 2 subpopulations with $N_e > 25$ ($N > 125$) with immigration rates <1 per generation.

(c) Census data of >20% annual decline in numbers over the past 2 years, or >50% decline in the last generation, or equivalent projected declines based on demographic projections after allowing for known cycles.

(d) Population subject to catastrophic crashes (>50% reduction) per 5 to 10 years, or 2 to 4 generations, with subpopulations highly correlated in their fluctuations.

or (2) Observed, inferred, or projected habitat alteration (i.e., degradation, loss, or fragmentation) resulting in characteristics of (1).

or (3) Observed, inferred, or projected commercial exploitation or ecological interactions with introduced species (predators, competitors, pathogens, or parasites) resulting in characteristics of (1).

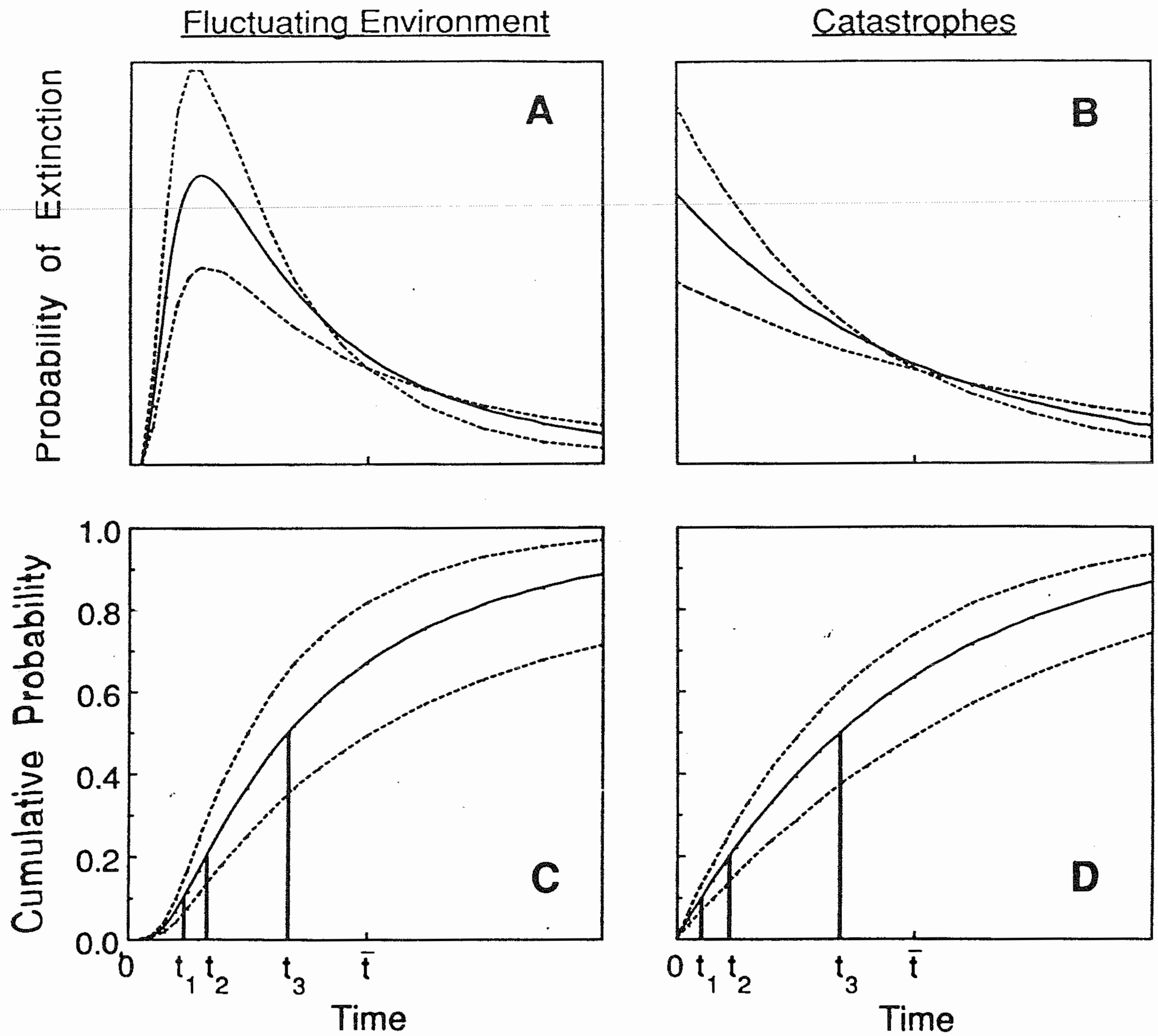

Figure 1. *Probability distributions of time to extinction in a fluctuating environment, inverse Gaussian distributions (A), or with catastrophes, exponential distributions (B). Corresponding cumulative extinction probabilities of extinction up to any given time are shown below (C and D). Solid curves represent the best estimates from available data and dashed curves represent different estimates based upon the likely range of variation in the parameters. t_1, t_2, and t_3 are times at which the best estimates of cumulative extinction probabilities are 10%, 20%, and 50%. $\bar{t}$ is the expected time to extinction in the solid curves.*

ENDANGERED:

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

(1) Any **two** of the following or any **one** criterion under CRITICAL

(a) Total population N_e < 500 (corresponding to actual N < 2,500).

(b) Population fragmented:

(i) ≤5 subpopulations with N_e > 100 (N > 500) with immigration rates <1 per generation, or

(ii) ≤2 subpopulations with N_e > 250 (N > 1,250) with immigration rates <1 per generation.

(c) Census data of >5% annual decline in numbers over past 5 years, or >10% decline per generation over past 2 generations, or equivalent projected declines based on demographic data after allowing for known cycles.

(d) Population subject to catastrophic crashes: an average of >20% reduction per 5 to 10 years or 2 to 4 generations, or >50% reduction per 10 to 20 years or 5 to 10 generations, with subpopulations strongly correlated in their fluctuations.

or (2) Observed, inferred, or projected habitat alteration (i.e., degradation, loss, or fragmentation) resulting in characteristics of (1).

or (3) Observed, inferred, or projected commercial exploitation or ecological interactions with introduced species (predators, competitors, pathogens, or parasites) resulting in characteristics of (1).

VULNERABLE:

10% probability of extinction within 100 years, or

(1) Any **two** of the following criteria or any **one** criterion under ENDANGERED.

(a) Total population N_e < 2,000 (corresponding to actual N < 10,000).

(b) Population fragmented:
(i) ≤5 subpopulations with N_e > 500 (N > 2,500) with immigration rates <1 per generation, or
(ii) ≤2 subpopulations with N_e > 1,000 (N > 5,000) with immigration rates <1 per generation.

(c) Census data of >1% annual decline in numbers over past 10 years, or equivalent projected declines based on demographic data after allowing for known cycles.

(d) Population subject to catastrophic crashes: an average of >10% reduction per 5 to 10 years, >20% reduction per 10 to 20 years, or >50% reduction per 50 years, with subpopulations strongly correlated in their fluctuations.

or (2) Observed, inferred, or projected habitat alteration (i.e., degradation, loss, or fragmentation) resulting in characteristics of (1).

or (3) Observed, inferred, or projected commercial exploitation or ecological interactions with introduced species (predators, competitors, pathogens, or parasites) resulting in characteristics of (1).

Prior to any general acceptance, we recommend that these criteria be assessed by comparison of the categorizations they lead to in particular cases with the results of formal viability analyses, and categorizations based on existing methods. This process should help to resolve uncertainties about both the practice of, and results from, our proposals. We expect a system such as this to be relatively robust and of widespread applicability, at the very least for most higher vertebrates. For some invertebrate and plant taxa, different kinds of criteria will need to be developed within the framework of the definitions above. For example, many of these species have very high rates of population growth, short generation times, marked or episodic fluctuations in population size, and high habitat specificity. Under these circumstances, it will be more important to incorporate metapopulation characteristics such as subpopulation persistence times, colonization rates, and the distribution and persistence of suitable habitats into the analysis, which are less significant for most large vertebrate populations (Murphy et al. 1990; Menges 1990).

Change of Status

The status of a population or species with respect to risk of extinction should be up-listed (from unlisted to VULNERABLE, from VULNERABLE to ENDANGERED, or from ENDANGERED to CRITICAL) as soon as current information suggests that the criteria are met. The status of a population or species with respect to risk of extinction should be down-listed (from CRITICAL to ENDANGERED, from ENDANGERED to VULNERABLE, or from VULNERABLE to unlisted) only when the criteria of the lower risk category have been satisfied for a time period equal to that spent in the original category, or if it is shown that past data were inaccurate.

For example, if an isolated population is discovered consisting of 500 individuals and no other information is available on its demography, ecology, or the history of the population or its habitat, this population would initially be classified as ENDANGERED. If management efforts, natural events, or both caused the population to increase so that 10 years later it satisfied the criteria of the VULNERABLE category, the population would not be removed from the ENDANGERED category for a further period of 10 years. This time lag in down-listing prevents frequent up-listing and down-listing of a population or species.

Uncertain or Conflicting Results

Because of uncertainties in parameter estimates, especially those dealing with genetics and environmental variability and catastrophes, substantial differences may arise in the results from analyses of equal validity performed by different parties. In such cases, we recommend that the criteria for categorizing a species or population should revert to the more qualitative ones outlined above.

Reporting Categories of Threat

To objectively compare categorizations made by different investigators and at different times, we recommend that any published categorization also cite the method used, the source of the data, a date when the data were accurate, and the name of the investigator who made the categorization. If the method was by a formal viability model, then the name and version of the model used should also be included.

Conclusion

Any system of categorizing degrees of threat of extinction inevitably contains arbitrary elements. No single system can adequately cover every possibility for all species. The system we describe here has the advantage of being based on general principles from population biology and can be used to categorize species for which either very little or a great deal of information is available. Although this system may be improved in the future, we feel that its use will help to promote a more uniform recognition of species and populations at risk of premature extinction, and should thereby aid in setting priorities for conservation efforts.

Summary

1. Threatened species categories should highlight species vulnerable to extinction and focus appropriate reaction. They should therefore aim to provide objective, scientifically based assessments of extinction risks.
2. The audience for Red Data Books is diverse. Positive steps to raise public awareness and implement national and international legislation benefit from simple but soundly based categorization systems. More precise information is needed for planning by conservation bodies.
3. An ideal system needs to be simple but flexible in terms of data required. The category definitions should be based on a probabilistic assessment of extinction risk over a specified time interval, including an estimate of error.
4. Definitions of categories are appropriately based on extinction probabilities such as those arising from population viability analysis methods.
5. We recommend three categories, CRITICAL, ENDANGERED, and VULNERABLE, with decreasing probabilities of extinction risk over increasing time periods.
6. For most cases, we recommend development of more qualitative criteria for allocation to categories based on basic principles of population biology. We present some criteria that we believe to be appropriate for many taxa, but are appropriate at least for higher vertebrates.

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Features

Draft IUCN Red List Categories, Version 2.2

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I. Introduction

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 recognized 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 organizations. 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.

The need to revise the categories has been recognized 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 to 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 with clear guidance on how to evaluate different factors that 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.

The proposals presented in this document result from a continuing process of drafting, consultation and validation exercises, and redrafting. 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: 1994 (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 emphasized.

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

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 guidelines followed.

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 Categorization 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 microorganisms. The criteria may also be applied within any specified geographical or political area although special 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 categorization 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

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 Fig. 1).

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 microorganisms). 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 in the criteria associated with threatened categories were developed through wide consultation, and 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

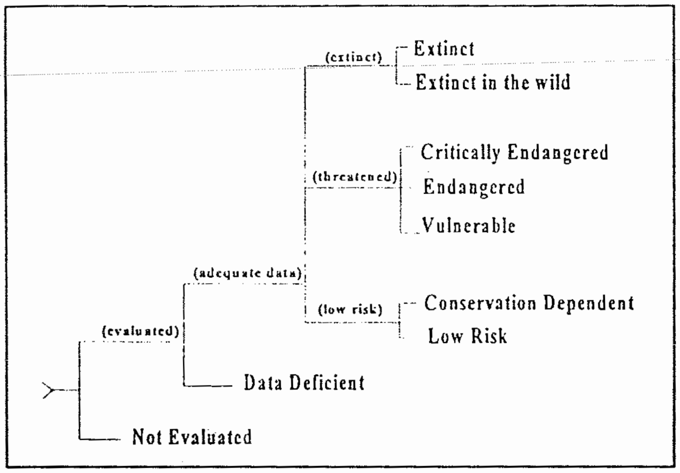

Figure 1. Structure of the Categories.

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 taxa, 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 to apply the criteria, as methods involving estimation, inference, and projection are emphasized 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 the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

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 recognize 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 emphasize here that a taxon requires conservation action even if it is not listed as threatened.

9. Documentation

All taxon lists including categorization 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 recognized 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 populations were 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

As circumstances change, re-evaluation of taxa against the criteria 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 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 should be made without delay.

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 kilometer or finer).

III. Definitions

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.

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).

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 characterized 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, behaviorally, 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.

Generation

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

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.

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.

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.

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 recolonization.

Extent of Occurrence
Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary that 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).

Area of Occupancy
Area of occupancy is defined as the area within the "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 km^2, 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).

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.

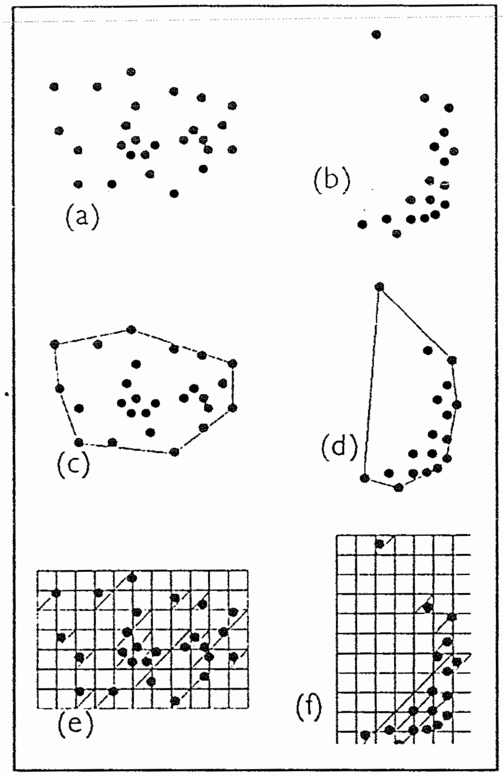

Figure 2. Two examples of the distinction between extent of occurrence and area of occupancy. (a) and (b) are the spatial distribution of known, inferred, or projected sites of occurrence. (c) and (d) show one possible boundary to the extent of occurrence, which is the measured area within this boundary. (e) and (f) show one measure of area of occupancy which can be measured by the sum of the occupied grid squares.

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 naturalized 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 20.

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 pages 20-21.

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 pages 21-22.

Conservation Dependent (CD)
Taxa that 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 program which directly affects the taxon in question. The cessation of this conservation program 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 (ii) those that are of less concern and (iii) 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 unfavorable 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, hybridization, 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 km^2 or area of occupancy estimated to be less than 10 km^2, *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 subpopulation.

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, hybridization, 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 5,000 km^2 *or* area of occupancy estimated to be less than 500 km^2, *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 occu-

pancy; (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 2,500 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 subpopulation.

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, hybridization, 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 km^2 or area of occupancy estimated to be less than 2,000 km^2, 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 1,000 mature individuals); (b) all individuals are in a single subpopulation.

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 characterized by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the ef-

fects 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.

VI. Some Examples of the Application of the Criteria

During the process of developing the new draft Red List categories and criteria, it has become clear that it is very hard to understand how the proposed new system actually works without seeing some worked examples of particular species. To assist in understanding the process, eight species have been chosen as examples. Most of these species are not particularly well-known, thus demonstrating that the criteria do not require large amounts of quantitative data to be available before they can be applied.

Ceratotherium simum

The white rhinoceros *Ceratotherium simum* is the least threatened of the world's five species of rhinoceros. The northern subspecies is Critically Endangered and is restricted to Garamba National Park in Zaire, where only 33 animals survive. The southern subspecies is largely confined to South Africa, where it has been increasing for many years under strict protection, and now numbers more than 6,000 individuals.

Criterion A. The species does not qualify as Threatened, since it is not in decline, nor is there any sign of breakdown in the protection system in South Africa that would result in a high level of poaching.

Criterion B. The species does not qualify as Threatened, since its area of occupancy is greater than 2,000 km^2.

Criterion C. The species does not qualify as Threatened, since although it has a population of less than 10,000 mature individuals, it is not in decline.

Criterion D. The species does not qualify as Threatened, since its population is greater than 1,000 mature individuals.

Conservation Dependent. The species certainly qualifies, since the cessation of the conservation programme in South Africa would result in the species qualifying as Threatened very rapidly.

Conclusion. List as Conservation Dependent.

Columba mayeri

The pink pigeon *Columba mayeri* is endemic to Mauritius, where it has declined to a tiny population of around 20 birds. A newly reintroduced popuation at a different site might offer the only hope for the species in the wild. Since the species obviously satisfies criterion D for Critically Endangered, it is not essential to test it against the other criteria. However, a Population Viability Analysis has been carried out on this species, which indicates a probability of extinction in the wild of 50% in two generations, hence qualifying as Critically Endangered.

Conclusion. List as Critically Endangered under Criteria D and E.

Eos cyanogenia

The black-winged lory *Eos cyanogenia* is a parrot that is restricted to the small Indonesian islands of Biak, Manim, Meos Num, Numfor, and Supiori. The species has almost certainly declined as a result of loss of forest habitat, though it is still reported to be relatively common on forested areas of Biak. International trade has accelerated since 1987, giving cause for concern for this species, especially in view of its very restricted distribution.

Criterion A. Given the number of birds reported in international trade, and the small wild population, a postulated decline of 50% in the last ten years, or a projected decline of 50% in the next ten years, is supportable. The species can therefore be listed as Endangered under criterion A.

Criterion B. The species is likely to have a distribution of less than 20,000 km², and is in decline, and since its distribution is severely fragmented, it satisfies this criterion at the Vulnerable level.

Criterion C. The species almost certainly satisfies this criterion at the Vulnerable level, since its population is believed to be less than 10,000 mature individuals, and its rate of decline is probably at least 20% during the last 10 years.

Conclusion. Since the species qualifies as Endangered under criterion A1c and Vulnerable under criteria B1 & B2e and C1, the former takes precedence, and it is listed as Endangered.

Eretmochelys imbricata

The hawksbill turtle *Eretmochelys imbricata* is a very widespread species, known to nest in at least 60 countries in the tropics and subtropics, but suspected to nest in more. Compared with some other marine turtle species, the total numbers appear to be quite small (a minimum of 15,000 - 25,000 females nest annually). It can be inferred that the relative rarity of the hawksbill is largely the result of prolonged over-exploitation for eggs and the international tortoiseshell trade.

Criterion A. Assuming the generation length to be 40 years, it is a supportable hypothesis that the species has declined by 50% over the last three generations (120 years), thus qualifying as Endangered.

Criterion B. The species does not qualify in view of its very wide distribution.

Criteria C and D. The species does not qualify, since more than 10,000 mature individuals survive.

Conclusion. List as Endangered under criterion A2c.

Dyscophus antongilii

This large frog is endemic to Madagascar, where it has a very small distribution in the east of the country, mainly between Maroantsetra and Andevoranto, and further south around Ambatovaky. The species favours swamps, shallow pools and water ditches, and although the status of the species is poorly known, it can be found in large concentrations. It is probably suffering from loss of habitat. The species appeared in the international pet trade prior to its listing on Appendix I in 1987.

Criteria A. It is unlikely that the decline in this species has amounted to, or will amount to, 50% in 20 years or five generations, and so does not qualify as Threatened under this criterion.

Criterion B. The area of distribution of this species is almost certainly less than 10,000 km². If it is assumed, probably correctly, that the species is in decline, and that its population is severely fragmented, then it would qualify as Vulnerable under criterion B.

Criteria C and D. Given that it can occur in large concentrations, the population of this species is probably greater than 10,000 mature individuals, and so the species does not qualify as Threatened under these criteria.

Conclusion. List as Vulnerable under criterion B1 & B2c.

Partula rosea

Partula rosea is a land snail that is endemic to the island of Huahine in French Polynesia. Its approximate range has been assessed by field biologists. Partulid snails have become extinct in recent years on all the surrounding islands following the introduction (either accidental or intentional) of the predatory snail *Euglandina rosea*. The last visit to the island by experts on *Partula* was in 1991, and no *Euglandina* were seen at that time. However, based on the colonisation of other islands in French

Polynesia, *Euglandina* is expected to invade during the next ten years.

Criterion A. Although currently stable, a decline of 50% over the next ten years is projected on the basis of the likely introduction of a predatory species, and the species thus qualifies as Endangered.

Criterion B. The species probably has an area of occupancy of less than 500 km^2, occurs at no more than five locations, and is facing a projected decline following the introduction of a predator, and thus qualifies as Endangered.

Criteria C and D. The species probably still has a large population, and so does not qualify under these criteria.

Conclusion. List as Endangered under criteria A2d and B1 & B2e.

Aztekium ritteri

Aztekium ritteri is one of the most unusual Mexican cacti, and is prized by cacti collectors. The population is estimated to number in the millions, but it is restricted to a single valley covering only 50 km^2. The species has probably declined somewhat, since it has been subject to heavy collecting for many years.

Criterion A. Although the species has probably declined, in view of its large population size, it seems unlikely that the collecting pressure has been sufficient to cause a decline of 50% over the last 20 years or five generations.

Criterion B. The species qualifies as Endangered under this criterion, in view of its area of occupancy of only 50 km^2, and the fact that it probably occurs in only one location, and is in decline.

Criteria C and D. The species does not qualify in view of its large population size.

Conclusion. List as Endangered under criterion B1 & B2e.

Paphiopedalum stonei

The species of slipper orchid is found in the limestone cliffs and hills of western Sarawak, Malaysia. It is in decline as a result of limestone quarrying and mining. It is also potentially at risk from international trade.

Criterion A. The species is believed to have declined in the past, or be likely to decline in the future, by at least 50% during 10 years or three generations, and as such qualifies as Endangered.

Criterion B. The species has an area of occupancy of less than 500 km^2, has a fragmented distribution, and is in decline, and so qualifies as Endangered.

Criteria C and D. The species probably has a population of more than 2,500 mature individuals, and so could not qualify as Endangered under these criteria. If its population is less than 10,000 mature individual, it would qualify and Vulnerable under criterion C.

Conclusion. List as Endangered under criteria A2b and B1 & B2c.

Georgina Mace
Simon Stuart

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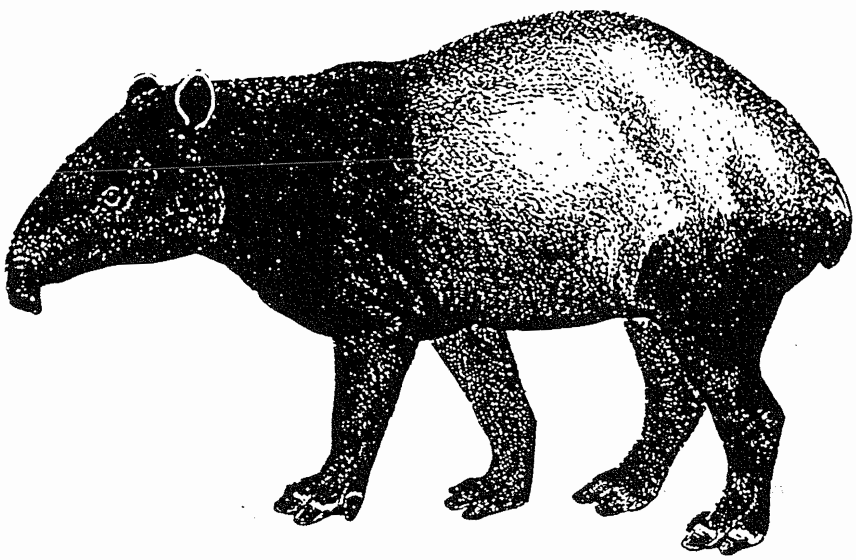

Part I: Listing by author (including some abstracts)

Part II: Listing by subject

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Reported in this paper is experience obtained from therapeutic application of Ivomec and Equalan (Merck,Sharp, and Dohme) to zoo animals. Ivermectin MSD was found to act strongly on scabies mites (Sarcoptes scabies) in tapir(Tapirus terrestris) and on intestinal nematodes in blackbuck(Antilope cervicapra) as well as on equine ascaridae and lesser and major equine Strongyli in Shetland pony. The same broad anthelminthic action of the substance was not confirmed, however in dromedary (Camelus bactrianus). Ivermectin had no effect either on coccidia. Since both preparations exhibited strong ascaricidal, insecticidal, and anthelminthic effectiveness, with hardly any side effects being caused, their final testing and therapeutic use is recommended for these and other species of zoo animals.
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The Baird's Tapir Tapirus bairdii (Gill, 1865), is an endangered animal throughout all its present distribution. Some remnant populations can still be found in Mexico. Originally, this species was distributed in seven states of southern Mexico, but it is possible that the tapir could be already extinct in the states of Veracruz, Yucatan, and maybe also in Tabasco. In Mexico, the total original habitat for the tapir covered an extensive area which now has been reduced to less than a half. Based on reports from several authors as well as records generated by the author as well as records generated by the author from 1984 to 1992, this

paper presents 36 records of distribution of the tapir in southern Mexico. Based on this analysis, it is concluded that the tapir occurs from the sea level to 1,900 meters in altitude and in several types of rainforest, savannahs, and cloud forests. The main characteristics of the tapir's habitat in some of the verified areas of its distribution are described and specific measures for the conservation of the species are proposed.
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The hemoglobins from a lowland tapir(Tapirus terrestris) were analyzed and the complete primary structure is described. The globin chains were separated on CM cellulose column in 8m urea and the amino-acid sequences were determined in the liquid phase sequenator.The results show that globin consists of two .alpha. chains (.alpha.I and .alpha.II) and .beta. major and .beta. minor components. The .alpha. chains differ only at one position: .alpha.I contains aspartic acid and .alpha.II glycine. The .beta. chains are heterogeneous: aspartic and glutamic acid were found at positions .beta.21 and .beta.73 of the .beta. major components and asparagine and serine at position .beta.139. In the .beta. minor components four positions were found with more than one amino acid, namely .beta.2, .beta.4, .beta.6, and .beta.56.
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CKX was used to immobilize 3 adult and 1 juvenile mountain tapirs. Subjective quality of anesthesia was judged to be good-excellent. (Xylazine 0.103 mg/kg, ketamine 0.26 mg/kg, and carfentanil 5.4 ug/kg) Induction and recovery were smooth and without complications. Due to the length of procedures performed, anesthesia was maintained with isoflurane and propofol. Propofol given as slow iv bolus to effect (~0.3 mg/kg). Heart rate, respiratory rate, and O2 saturation were stable throughout the procedures. All animals were reversed with naltrexone at a rate of 100:1 and yohimbine (0.13 mg/kg iv). No procedures were performed with carfentanil as a sole induction agent in mountain tapirs.
Anesthesia.

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one major component (betaBp) with identical electrophoretic properties, which is shared by both beta(H(igh))-crystallin and beta(L(ow))-crystallin. This suggests a conservative character of this polypeptide in evolution. The most striking differences between artiodactyls and perissodactyls are found in the beta(H)-aggregates, especially apparant is the occurence of the polypeptide, designated as betaB1 in the calf, in the investigated artiodactyl species, but not in the perissodactyls. This results is sustained by immunodiffusion studies. Moreover these latter experiments also indicate that in whale and dog a polypeptide occurs, which is immunologically related to betaB1 from the calf. The resultsmay be explained bby the loss or profound structural change of this polypeptide in the course of perissodactyl evolution.
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Studies on tapirs in the Santa Rosa National Park in 1981-1983 indicated that they preferred multi-layered forest containing mature evergreen trees, woody shrubs and saplings in the understorey and patches of dense cover for dattime retreat, all located near permanent water. The seeds and fruit parts of 33 species were identified in tapir dung. In studies with the seeds of 6 species, 4 showed improved germination potential after passing through the gut of the tapir.
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Three tapris were radio-collared and tracked both from the air and the ground in dense rain forest. Radio waves, near 154 KHz, were severely attenuated and this limited reception distances of supplied transmitters

to less than 6 miles when tracking from the air and to less than 1.5 miles from ground stations. Effective seaarch distances from ground stations, however, usually were less than 0.5 miles. Receiving antennas at ground stations had to be held in the horizontal plane. The home range of one male was 4.9 mi2 and overlapped the home ranges of several other tapirs.
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In the rainforest study area within the Taman Negara Park in the north-central part of the Malay Peninsula more than 115 species of 70 genera in 40 plant families were found to have been browsed by the rare Malayan tapir (Tapirus indicus). The families Euphorbiacea and Rubiaceae included 42% of species taken. Feeding activities were not concentrated in particular localities although most browsing occurred in mesic or hydric areas. The stems of plants browsed by tapirs were usually less than 2.7 cm in diameter. In addition to woody forage young leaves of some herbaceous plants were also eaten. For 46 species of food plants of tapirs which were studied, over 75% of the available forage from 27 species was eaten and these were considered to be the most highly preferred foods. Analysis of faecal samples indicated that forages were only coarsely chewed and fruit parts and seeds were usually present; fruits of woody plants were taken from the forest floor. It is suggested that tapirs prefer primary to secondary forest and it is possible that tapirs may not be able to survive where primary rain forests are being felled.
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Gross lesions suggestive of severe hepatoenteropathy and myopathy were noted in a 4.5-yr-old Brazilian tapir from a zoo in Michigan. The major microscopic lesions were granulomatous hepatitis and haemorrhagic enteritis associated with non-operculated eggs compatible with those of the Schistosomatidae (probably Heterobilharzia americana). Skeletal muscle and tongue contained foci of severe acute myodegeneration and necrosis. The hepatic vitamin E value of 1.3 ppm dry weight was considered critically low.
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Part II
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