HORNBILL CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

FIRST REVIEW DRAFT

15 February 1994

Report from the workshop held
24-26 September 1991, Singapore

Edited by
Wendy Worth, Christine Sheppard, Alan Kemp, Susie Ellis, and Ulysses Seal

Working Group Leaders
Carlo Custodio, S. Ainul Hussain, Alan Kemp, Pilai Poonswad, Endang Priyambada

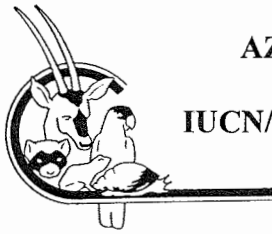
Compiled by the Workshop Participants

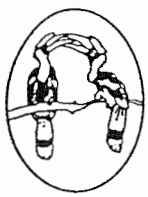
A Collaborative Workshop

BirdLife International Hornbill Specialist Group

AZA Hornbill Taxon Advisory Group

IUCN/SSC Captive Breeding Specialist Group





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HORNBILL
CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

FIRST REVIEW DRAFT
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EXECUTIVE SUMMARY

Hornbill taxa were reviewed taxon-by-taxon to assign a category of threat and to recommend intensive conservation action. The recommendations contained in the Hornbill Conservation Assessment and Management Plan are based only on conservation criteria; adjustments for political and other constraints will be the responsibility of regional plans.

For this exercise, 84 distinct taxa (subspecies or species if no subspecies are contained therein) of hornbills were considered. 47 of the 84 taxa (56%) were assigned to one of three categories of threat, based on the Mace-Lande criteria:

Critical	5 taxa
Endangered	13 taxa
Vulnerable	29 taxa

37 taxa were assigned to the Secure category, according to Mace-Lande criteria.

33 of the 84 taxa (39%) were recommended for Population and Habitat Viability Assessment workshops. 17 of the 84 taxa (20%) were recommended for more intensive *in situ* management.

63 of the 84 taxa (76%) are recommended for research:

Survey	45 taxa
Taxonomic research	39 taxa
Husbandry research	4 taxa

30 of the 84 hornbill taxa (36%) were recommended for one of two time-frames for development of captive programs (based in part on Mace-Lande criteria):

Intensive program, initiated within 0-3 years	11 taxa
Initiate in the future (>3 years)	19 taxa

However, husbandry techniques are not in place for these taxa at present, and these techniques will need to be worked out with surrogate species.

An additional 13 taxa were not currently recommended for captive programs, but may be reconsidered following a formal Population and Habitat Viability Assessment or when further data or husbandry techniques become available. Twelve taxa were not recommended for captive programs.

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SECTION 1

WORKSHOP SUMMARY AND RECOMMENDATIONS

HORNBILL CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

Introduction.

Reduction and fragmentation of wildlife populations and habitat is occurring at a rapid and accelerating rate. For an increasing number of taxa, the results are small and isolated populations at the 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 will not be quelled, and which will lead to a decreased capacity for all other species 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.

The Problems Facing Hornbills.

The 54 species of Bucerotidae, or hornbills, are distributed in the old world tropics in two types of habitat - tropical rain forest and savanna. The 30 Asian species are primarily forest dwellers, while the 24 African species inhabit the savanna and woodland. They vary in size from 40 cm to 150 cm, but are uniformly colored, black and white or brown. Their most vivid color is found on their uniquely shaped bills and casques, which are also their identifying characteristic. Although often quite large, the casques are made of a lightweight, spongy material. Only the Asian helmeted hornbill (*Rhinoplax vigil*) has a solid casque which was once in great demand as ivory for carvings.

The unusual breeding behavior of the hornbill, in which the female seals herself into the nest cavity, makes them dependent upon large diameter trees for nesting sites. These same trees, usually dipterocarps, are in great demand for the logging industry. Throughout their distribution, particularly in Asia, hornbills are under tremendous pressure from habitat loss and degradation of the environment.

Hunting is also a threat to hornbill populations. The female is especially vulnerable when she is sealed into her nest. With nest cavities in short supply, competition from other animals makes it even more difficult to find suitable nest sites.

The large bills of this family have been suggested as a reason why hornbills are the only birds with the first two neck vertebrae (axis and atlas) fused. The casque develops for several years

and in many species is a determinate factor in age, sex, and species.

The unusual appearance and large size of most hornbills make them excellent candidates for flagship species for conservation action. In Asia they are often the largest avian fruit-eaters in their habitat; undigested remains, such as seeds, are regurgitated or defecated. There have been several studies, most notably by Leighton, over the past decade showing their importance as primary seed dispersers. Their densities also correspond with the level of habitat deterioration making them important indicators of forest health (Poonswad, pers. comm.).

Because of hornbills' conspicuous and appealing presence combined with the drastic alteration of their habitat, they are considered keystone species. Some of the endemic island species have very vulnerable populations and mainland species are similarly threatened. This document should serve as a guideline for conservation and management priorities.

Conservation Assessment and Management Plans (CAMPs).
Within the Species Survival Commission (SSC) of IUCN-The World Conservation Union, the primary goal of the Captive 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 Conservation Assessment and Management Plans (CAMPs), both on a global and a regional basis, with the goal of facilitating an integrated approach to species management for conservation.

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 Mace-Lande 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.

The CAMP Workshop.
The CAMP process assembles expertise on wild and captive management for the taxonomic group under review in an intensive and interactive workshop format. In September of 1991, 49 individuals, representing 15 countries, met in Singapore to develop conservation strategies for hornbills. This group was largely self-selected from over 100 individuals invited to attend, but represented field biologists, non-governmental organizations, wildlife and forestry experts, conservation biologists, taxonomists, geneticists, captive managers, veterinarians. This group attempted to review and refine conservation strategies for hornbills. Participants are listed in Section 9.

For the purposes of initial examination, the maximum number of published sub-species units was used (i.e., Sanft, 1960). Additional taxonomic information was incorporated into each

working group discussion, where available.

While there may be agreement on the number of species, it is expected that the number of taxa will be subject to discussion. As emphasized previously, the Hornbill Conservation Assessment and Management Plan will be an evolving document; new classification data will be assimilated into the Plan as it becomes available.

CAMP Workshop Goals.
The goals of the Hornbill CAMP workshop were:
1) To review the population status and demographic trends for hornbills, to test the applicability of the Mace-Lande criteria for threat, and to discuss management options for hornbill taxa.

2) To provide recommendations for *in situ* and *ex situ* management, research and information-gathering for all hornbill taxa including: recommendations for PHVA workshops; more intensive management in the wild; taxonomic research, and survey or other specific research.

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

Five working groups were developed to consider in detail the taxa occurring in Africa, India, Indonesia, the Philippines and peninsular Southeast Asia (Thailand and Malaysia). Participants worked together in these small groups to achieve the above goals. Additional working groups were formed to consider overall conservation action priorities and specific strategies.

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

Assignment of Hornbill Taxa to Mace-Lande Categories of Threat.
All hornbill 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 11). 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) Conservation Assessment and Management Plans 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 hornbill taxa were not available or were available for taxa within a limited part of their distribution. In all cases, conservative numerical estimates were used. **Where population numbers are estimated, these estimates represent first-attempt, order-of-magnitude educated guesses that are hypotheses for falsification. As such, the workshop participants emphasize that these guesstimates should not be used as an authoritative estimate for any other purpose than was intended by this process.**

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

In assessing threat according to Mace-Lande criteria, workshop participants also used information on the status and interaction of habitat and other characteristics. Information about population trends, fragmentation, range, and stochastic environmental events, real and potential, were also 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. Assignment to Mace-Lande categories of threat for the 72 taxa examined during this CAMP exercise are presented in Table 2. Specific taxa within each category of threat are presented in Section 3.

Table 2. Threatened hornbill taxa - Mace-Lande categories of threat.

MACE-LANDE CATEGORY	NUMBER OF TAXA	PERCENT OF TOTAL
Critical	5	6%
Endangered	13	15%
Vulnerable	29	35%
Secure	37	44%
TOTAL	84	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. A comparison of Mace-Lande and IUCN classification results is presented in Table 3. Seven of the hornbill taxa assigned to a Mace-Lande category of threat are listed as threatened under IUCN classification; 37 taxa assigned to Mace-Lande categories of threat are not listed in the *1990 IUCN Red List of Threatened Animals*.

Table 3. Threatened hornbills of the world - comparison of Mace-Lande and current IUCN categories of threat.

MACE-LANDE	IUCN CATEGORIES						
	END	VUL	RARE	INDET	K	NOT	TOTAL
Critical	0	1	0	0	0	4	5
Endangered	0	0	2	0	0	11	13
Vulnerable	0	0	2	1	1	25	29
TOTAL	0	1	4	1	1	37	47

Regional Distribution of Threatened Taxa.
Regional distribution of threatened taxa is presented in Table 4. As shown, 97% of threatened hornbill taxa are found in the Asian region. Detailed spreadsheets and taxon data sheets for taxa within each region examined (Indian Subcontinent, Philippines, Southeast Asia, Indonesia, and Africa) are presented in Sections 4-8, respectively.

Table 4. Regional distribution of hornbill taxa according to Mace-Lande category.

MACE-LANDE	Africa	Asia	TOTAL
Critical	0	5	5
Endangered	0	13	13
Vulnerable	1	28	29
Secure	27	10	37
TOTAL	28	56	84

Threats to hornbills.
For the purposes of the CAMP process, threats were defined as "immediate or predicted events that are or may cause significant population declines." The primary threats outlined by workshop participants for hornbills include: habitat destruction; and hunting. Trade is also a threat, most notably for Asian species. The workshop participants as a group developed a

recommendation to place all hornbills on CITES Appendix II. The text of this resolution follows:

> "Many Asian hornbill species are endangered by human activities. For this reason, the Hornbill Global Conservation Action Group, including over 50 experts, field scientists, taxonomists, wildlife managers, conservation biologists, government agencies, and private individuals from 14 countries, met in September 1991 to confer on strategies for conserving this important group of birds. In order to monitor trade and increase protection for Asian hornbills, we emphatically endorse the resolution proposed by the Netherlands, to list all Asian hornbill species* on CITES Appendix II.
> *with the exception of *Rhinoplax vigil*, which will remain on CITES Appendix I, because of its exploitation for the trade in hornbill ivory."

This resolution was accepted and approved at the meeting of the CITES Secretariat in Kyoto, Japan, in 1991.

Island Forms: Conservation Implications and Threats.
Much of the diversity of the Bucerotidae derives from their extensive radiation on islands. The problems faced by small island populations are well-known (e.g., Moors, 1985; Vitousek, 1988). Because island populations are typically small, they must be monitored regularly to assess their status. Island environments also impose particular problems on wildlife managers. For example, the acquisition of large wilderness areas to protect endangered island animals is usually impossible because of other pressing demands on limited land. Thus conservation programs often must be designed to accommodate wildlife populations within a multiple-use landscape.

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 5, were: Population and Habitat Viability Assessment (PHVA) workshops; survey; taxonomic research; husbandry 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 convening 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 hornbill 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.

Table 5. Hornbill research and management recommendations.

MACE-LANDE	PHVA	SURVEY	WILD MGMT	TAXON RESRCH	HUSB RESRCH
Critical	4	2	2	2	1
Endangered	13	9	3	9	3
Vulnerable	15	20	9	18	0
Secure	1	14	3	10	0
TOTAL	33	45	17	39	4

Captive Program Recommendations.
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. This may include: 1) serving as genetic and demographic reservoirs that can be used to reinforce wild populations whether 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) serving as living ambassadors that can educate the public as well as generate funds for *in situ* conservation.

It is proposed that, if 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 insular taxa, these issues must be addressed and resolved within the next several years.

For a few of the hornbill taxa, it was determined that a captive component would be necessary to contribute to the maintenance of long-term viable populations. There may be problems with interchange between captive and wild populations with regard to disease, logistics, and financial limitations.

It is essential to note, however, that husbandry techniques are not in place for most hornbill taxa at present, and these techniques will need to be worked out with surrogate species.

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The establishment of self-sustaining captive populations is not the only management option available for hornbills. Incorporating "captive propagation technology" or "field application of captive propagation techniques" (e.g., double-clutching, translocation, transitional aviaries, cross-fostering and supplemental feeding) and field management techniques (e.g., into long-term conservation programs) is also valuable, and for some cases, more feasible than establishing new captive programs with the more endangered taxa.

During the CAMP workshop, all hornbill 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 and trends, recommendations for captive programs were made. These recommendations, by category of threat, are presented in Table 6. Recommendations for levels of programs are presented in the various spreadsheets in Sections 2-8, as is information concerning the current populations of Bucerotidae in captivity.

Table 6. Captive program recommendations* for hornbills by Mace-Lande threat category.

MACE-LANDE	Initiate immediately 0-3 yrs	Initiate future > 3 yrs	Not currently recommended pending data or PHVA	No program recommended
Critical	2	2	1	0
Endangered	4	3	3	2
Vulnerable	3	9	8	7
Secure	0	14	3	28
TOTAL	9	28	15	37

There were several workshop participants with expertise in captive breeding/management of hornbills; these individuals were able to assess the degree of difficulty of propagation for each of the taxa considered (see Table 7 in Section 3 for a spreadsheet with all taxa). Again, it is clear that captive propagation techniques are not in place for the majority of taxa, and that these techniques need to be refined and improved before acting on recommendations for the establishment of new captive programs. These participants identified non-threatened taxa which could be used as surrogates for further refinement of captive husbandry and propagation techniques for threatened taxa:

CRITICAL TAXA	**SURROGATE**
Penelopides panini ticaensis	Taxa probably extinct
Penelopides panini subnigra	Taxa probably extinct
Rhyticeros leucocephalus waldeni	*Rhyticeros cassidix cassidix*
Rhyticeros everetti	*Rhyticeros cassidix cassidix*
Buceros rhinoceros sylvestris	*Buceros rhinoceros rhinoceros*

ENDANGERED TAXA	**SURROGATE**
Anthrococeros coronatus coronatus	*Anthrococeros coronatus convexus*
Anthrococeros marchei	*Anthrococeros coronatus convexus*
Aceros nipalensis	Surrogate not identified
Ptilolaemus tickelli austeni	SE Asian population of same *(Vulnerable)*
Ptilolaemus tickelli tickelli	*Ptilolaemus tickelli austeni (Vulnerable)*
Rhyticeros narcondami	*Rhyticeros undulatus*
Rhyticeros corrugatus rugosus	*Rhyticeros undulatus*
Buceros bicornis homrai	*Buceros rhinoceros rhinoceros,* existing population of *B. bicornis*
Buceros bicornis bicornis	*Buceros rhinoceros rhinoceros* existing population of *B. bicornis*
Buceros hydrocorax hydrocorax	*Buceros rhinoceros rhinoceros*
Buceros hydrocorax semigaleatus	*Buceros rhinoceros rhinoceros*
Buceros hydrocorax mindanensis	*Buceros rhinoceros rhinoceros*
Buceros rhinoceros borneoensis	*Buceros rhinoceros rhinoceros*
Penelopides panini mindorensis	Surrogate not identified
Penelopides panini basilanica	Surrogate not identified

Other actions that were identified by this group included a need for a complete census of Asian zoos, and a comparative study of *Buceros bicornis* and *Buceros rhinoceros* management in captivity.

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SECTION 2

SPREADSHEET CATEGORY DEFINITIONS AND SPREADSHEET FOR ALL HORNBILL 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.

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.

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.

Ar	Criteria
A	< 50,000 square kilometers (smaller than Bhutan)
AA	Island < 50,000 square kilometers
B	50,000-99,000 square kilometers (between Bhutan and Moluccan Islands)
C	100,000-499,000 square kilometers (smaller than Thailand)
D	500,000-999,000 square kilometers (between Thailand and Indonesia)
E	> 1,000,000 square kilometers (larger than Indonesia)

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

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

THREATS: Immediate or predicted events that are or may cause significant population declines.

H	Hunting
Hy	Hybridization
I	Inter-specific competition
L	Habitat Loss
N	Pollution
P	Predation
S	Poison (lead)
T	Trade

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

WILD MANAGEMENT: Is more intensive in situ management recommended?
Yes or No?

TAX/SRV/HUSB

Tax	Taxonomic relationships need further investigations
Srv	Survey work in the wild is needed
Hus	Husbandry research is needed

CAPTIVE PROGRAMS

REC: Level of Captive Program

I = **Intensive.** Captive population should be developed and managed that is sufficient to preserve 90% of the genetic diversity of a population for 100 years (90%/100). Program should be developed within 3-5 years. This is an emergency program based on the present availability of genetically diverse founders.

NUC = **Nucleus.** Initiate a captive program in the future. Captive population should be developed and managed that is a nucleus (smaller than that needed for the intensive program) organized with the aim to represent as much of the wild gene pool as possible and to provide the potential for expansion into an intensively managed population in needed. This program may require periodic exchange of genetic material between the captive and wild population, as indicated by appropriate analyses.

N = **No.** A captive program is not currently recommended

P = **Pending.** A captive program is not currently recommended but may be reconsidered pending further data

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

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

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

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

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

Table 7. HORNBILL TAXA (ALL)

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
1	BUCEROTIDAE																
2	TOCKUS	BIRDSTRIS		INDIA	>10,000	4	1	S	E	S	L	N	N			3	0
3	TOCKUS	FASCIATUS	(2 SUBSPP)	SENEGAMBIA E.TO UGANDA, N.ANGOLA	>1,600,000	4	2	S	?	S	NONE	N		TAX	N	3	
4	TOCKUS	ALBOTERMINATUS	(4 SUBSPP)	S.ETHIOPIA, S.AFRICA, ANGOLAE TO MOZAMBIQUE & TANZANIA	>1,800,000	1	4	S	?	S	NONE	N		SRV, TAX	N	3	
5	TOCKUS	BRADFIELDI		N.NAMIBIA, S.ANGOLA, W.ZAMBIA, NWZIMBABWE,N. BOTSWANA	396,800	4	1	S?	?	S	NONE	N		--	N	3	
6	TOCKUS	PALLIDIROSTRIS	(2 SUBSPP)	S.ANGOLA E. TO S.TANZANIA &MOZAMBIQUE	1 MILLION	4	2	S	?	S	NONE	N		--	N	3	
7	TOCKUS	NASUTUS	(3 SUBSPP)	SAVANNAS OF SUBSAHARAN AFRICA	>3 MILLION	1	3	S	?	S	NONE	N		TAX	N	3	
8	TOCKUS	HEMPRICHII		ETHIOPIA, C.KENYA, N.SOMALIA&SUDAN	422,400	4	1	S?	?	S	NONE	N		--	N	3	
9	TOCKUS	MONTEIRI		S.ANGOLA & N.HALF NAMIBIA	78,000	1	1	S	?	S	NONE	N		--	N	3	
10	TOCKUS	GRISEUS		W.INDIA, SRI LANKA	<10,000	4									NUC	3	

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
11	TOCKUS	GRISEUS	GRISEUS	W INDIA	<10,000	4		D	B	V	L	Y	Y	SRV	NUC	3	0
12	TOCKUS	GRISEUS	GINGALENSIS	SRI LANKA	5,000 -10,000	4		0	AA	V	L	Y	Y	SRV	NUC	3	0
13	TOCKUS	HARTLAUBI	(2 SUBSPP)	LIBERIA E. TO W. UGANDA, S. TO ZAIRE	>1 MILLION	4	2	S?	?	S	L	N		--	N	3	
14	TOCKUS	CAMURUS	(2 SUBSPP)	LIBERIA E. TO W.UGANOA, S. TO ZAIRE	>700,000	4	2	S?	?	S	NONE	N		--	N	3	
15	TOCKUS	ERYTHRORHYNCHUS	(3 SUBSPP)	SUBSAHARAN AFRICAN SAVANNAS	>500,000	1	3-5	S	?	S	NONE	N		--	N	3	
16	TOCKUS	FLAVIROSTRIS	(3 SUBSPP)	ETHIOPIA S.TO N.TANZANIA, S.SUDAN & E. UGANDA	>600,000	4	2	S?	?	S	UNK	N		--	N	3	
17	TOCKUS	LEUCOMELAS		S. ANGOLA & MOZAMBIQUE S.TO S.AFRICA	408,000	1	2	S	?	S	NONE	N		SRV	N	3	
18	TOCKUS	DECKENI		S.ETHIOPIA, W.SOMALIA, KENYA, N.TANZANIA, E.UGANOA	323,000	4	2	S?	?	S	NONE	N		TAX	N	3	
19	TOCKUS (TROPICANUS)	ALBOCRISTATUS				4											
20	TOCKUS (TROPICANUS)	ALBOCRISTATUS	ALBOCRISTATUS	SIERRA LEONE TO IVORY COAST	<10,000	4	2	D	B	S	L	N			N	3	

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
21	TOCKUS (TROPICANUS)	ALBOCRISTATUS	MACROURUS	GHANA, TOGO	<10,000	4	2	D	A	S	L	N			N	3	
22	TOCKUS (TROPICANUS)	ALBOCRISTATUS	CASSINI	W.NIGERIA TO GABON & UGANDA	>10,000	4	1	D	D	S	L	N			N	3	
23	BERENICORNIS	COMATUS		SUNDA SHELF	5,000 -10,000	4	4	D+	C	V	L,H	N		TAX, SRV	P	3	20+
24	PTILOLAEMUS	TICKELLI			<10,000	4	>2	D	B	V?	L				P	3	
25	PTILOLAEMUS	TICKELLI	TICKELLI	THAILAND BURMA	<2,500	4	1	D	A	E	L	Y		SRV	P	3	0
26	PTILOLAEMUS	TICKELLI	AUSTENI	INDIA,BURMA INDOCHINA, THAILAND	<5,000 2,500- INDIA	4	3	D+	B A	V E	L,H	Y	Y	SRV	P	3	0
27	ANORRHINUS	GALERITUS		SUNDA SHELF VIETNAM?	>10,000	4	3	D-	D	S	L H	N		SRV	N	3	10+
28	PENELOPIDES	PANINI		PHILIPPINES											NUC	3	
29	PENELOPIDES	PANINI	PANINI	PANAY,NEGROS MASB.,GUIM.	<5,000	4	4	D	AA	V	L,H	Y		TAX, SRV	NUC	3	0
30	PENELOPIDES	PANINI	MANILLOE	LUZON, CATAN, MARINDUQUE	<10,000	4	3	D	AA	V	L,H	Y		TAX, SRV	I	3	50-100
31	PENELOPIDES	PANINI	SUBNIGRA	PDLLILO	>250	4	1	D	AA	C	L,H	Y		TAX, SRV	NUC	3	0
32	PENELOPIOES	PANINI	MINDORENSIS	MINDORO	<2,500	4		D	AA	E	L,H	Y		TAX, SRV	N	3	0?
33	PENELOPIOES	PANINI	TICAENSIS	TICAO	<2,500	4		D	AA	C	L				NUC	3	
34	PENELOPIDES	PANINI	SAMARENSIS	SAMAR,LEYTE, BOHOL	>10,000	4	3	D	AA	V	L,H	Y		SRV	NUC	3	?

	TAXON			WILD POPULATION										CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
35	PENELOPIDES	PANINI	AFFINIS	MINDANAD, DINAGAT	10,000	4	2	D	AA	V	L,H	Y		TAX, SRV	NUC	3	?
36	PENELDPIDES	PANINI	BASILANICA	BASILAN	<250	4	1	D	AA	E	L,H	Y		TAX, SRV	NUC	3	?
37	PENELOPIDES	EXARHATUS		SULAWEZI											N	3	
38	PENELOPIDES	EXARHATUS	EXARHATUS	N SULAWEZI	>10,000	4	2	D	B	S	L	P		TAX, SRV	P	3	<10
39	PENELOPIDES	EXARHATUS	SANFORDI	S SULAWEZI	<10,000	4	4	D	A	V	L			TAX	N	3	<10
40	ACEROS	NIPALENSIS		INDIA, NEPAL TD THAILAND	5-10,000	4	3	D	B	E	L H	Y	Y	SRV	P	3	0
41	ANTHRACOCEROS	CORONATUS														3	
42	ANTHRACOCEROS	CDRONATUS	CORDNATUS	INDIA	5-10,000	4	2	D	B	V?	L	Y	Y	TAX	N	3	
43	ANTHRACDCEROS	CORDNATUS	CORONATUS	SRI LANKA	<2,500	4	1	D	AA	E	L	Y	Y	TAX	NUC	3	
44	ANTHRACOCERDS	CORONATUS	ALBIROSTRIS	INDIA, BHUTAN TD N MALAYA	>>10,000	4	5?	D	E	V?	L	N	Y	TAX, SRV	NUC	3	8?
45	ANTHRACOCEROS	CORONATUS	CONVEXUS	MALAYA TD BALI	>10,000	4	30	D-	D	S	L	N		TAX	NUC	3	10?
46	ANTHRACOCEROS	MALAYANUS													NUC	3	12+
47	ANTHRACDCEROS	MALAYANUS	MALAYANUS	MALAYA SUMATRA	<5-10,000	4	2	D	C AA	V?	L	N		TAX, SRV	N	3	
48	ANTHRACOCEROS	MALAYANUS	DEMINUTUS SSP.N.	BORNED	>>10,000	4	1	D	C	V?	L	N		TAX, SRV	NUC	3	

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
49	ANTHRACOCEROS	MONTANI		SULU ARCHIP.	<2,500	4	2	D	AA	V?	L,H	Y		SRV	NUC	3	?
50	ANTHRACOCEROS	MARCHEI		PALAWAN ARCH.	250-2500	4		D	AA	E	L,T,H	Y			NUC	3	0?
51	RHYTICEROS	NARCONDAMI		NARCONDAM	<500			S	AA	E	L	Y		TAX	N	3	
52	RHYTICEROS	UNOULATUS															
53	RHYTICEROS	UNOULATUS	UNDULATUS	INDIA TO BALI	>10,000		5	D	B	S	L,T,H	Y N	Y Y	SRV	I NUC	3	1+
54	RHYTICEROS	UNDULATUS	AEQUABILIS SSP.N.	BORNEO SABAH	<10,000 2,500-5,000		2	D+	C	V	L,T	N	Y	TAX, SRV	P	3	1+
55	RHYTICEROS	CORRUGATUS															
56	RHYTICEROS	CORRUGATUS	CORRUGATUS	BORNEO	5,000-10,000 <2,500		1	D+	A	V	L,T,H	Y		SRV	P	3	1+
57	RHYTICEROS	CORRUGATUS	RUGOSUS	MALAYA, SUMATRA	2,500-5,000 <2,500		2	D+	B AA	V E	L,T	Y		SRV, TAX	I	3	1+
58	RHYTICEROS	LEUCOCEPHALUS		PHILIPPINES													
59	RHYTICEROS	LEUCOCEPHALUS	LEUCOCEPHALUS	MINDANAO, CAMIGUIN	>10,000		2	D	AA	V	L,H	Y		SRV, TAX	I	3	1+
60	RHYTICEROS	LEUCOCEPHALUS	WALDENI	PANAY,NEGROS GUIMARAS	250-5,000		3?	D	AA	C	L,H	Y		SRV, TAX	P	3	

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
61	RHYTICEROS	CASSIDIX		SULAWEZI													
62	RHYTICEROS	CASSIDIX	CASSIDIX	SULAWEZI	>10,000		4	D	B	S	L	N		SRV, TAX	I	3	5
63	RHYTICEROS	CASSIDIX	BREVIROSTRIS	MUNA, BUTON	<2,500		2	D+	AA	V	L	N		SRV, TAX	P	3	
64	RHYTICEROS	EVERETTI		SUMBA	<250			D+	AA	C	L H	Y					
65	RHYTICEROS	SUBRUFICOLLIS		INDIA, BURMA TO SUMATRA	<2,500?		2	D	B	V?	L	Y		TAX,S RV	P	3	
66	RHYTICEROS	PLICATUS															N
67	RHYTICEROS	PLICATUS	PLICATUS	CERAM, AMBOINA	<10,000		2	D	AA	V	L	N		TAX	N	3	N
68	RHYTICEROS	PLICATUS	RUFICOLLIS	W NEW GUINEA PLUS ISLANDS	>10,000		11	D	C	S	L	N		TAX	N	3	N
69	RHYTICEROS	PLICATUS	JUNGEI	E NEW GUINEA	>10,000	4		D	C	S	L	N		TAX	N	3	
70	RHYTICEROS	PLICATUS	DAMPIERI	BISMARK ARCHIPELAGO	<10,000	4	3	D	AA	V	L	N		TAX	N	3	
71	RHYTICEROS	PLICATUS	HARTERTI	W SOLOMON IS.	<10,000	4	4	D	AA	V	L	N		TAX	N	3	
72	RHYTICEROS	PLICATUS	MENDANAE	S SOLOMON IS.	<10,000	4	5	D	AA	V	L	N		TAX	N	3	
73	CERATOGYMNA	ELATA		W. AFRICA - CAMEROON W. TO S. SENEGAL	>10,000	4	3	D	B	V	L,H	Y	Y	SRV	I	3	
74	CERATOGYMNA	ATRATA		LIBERA E. TO UGANDA AND S TO N.ANGOLA	>10,000	4	4	D	E	S	L,H	N	N	SRV	N	3	

	TAXON			WILD POPULATION										CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
75	CERATOGYMNA (BYCANISTES)	CYLINDRICUS															
76	CERATOGYMNA (BYCANISTES)	CYLINDRICUS	CYLINDRICUS	LIBERIA E. TO W. UGANDA	<10,000	4	3	D	E	S	L	N		SRV	N	3	
77	CERATOGYMNA (BYCANISTES)	CYLINDRICUS	ALBOTIBIALIS	CONGO FORESTS	>10,000	4	1	D	D	S	L	N		--	N	3	
78	CERATOGYMNA (BYCANISTES)	SUBCYLINDRICUS		CÔTE D'IVOIRE E. TO W.UGANDA S. TO N.ANGOLA	?	1	5	S	?	S	L	N		SRV	N	3	
79	CERATOGYMNA (BYCANISTES)	BREVIS		ETHIOPIA S. TO ZIMBABWE	?	4	?	S?	?	S	L	N		SRV	N	3	
80	CERATOGYMNA (BYCANISTES)	BUCINATOR		S. TANZANIA S. TO S. AFRICA, W. TO ANGOLA & ZAIRE	>10,000	4	1	D	E	S	L	N		SRV	N	3	
81	CERATOGYMNA (BYCANISTES)	FISTULATOR				4											
82	CERATOGYMNA (BYCANISTES)	FISTULATOR	FISTULATOR	W. GUINEA RAINFORESTS	<10,000	4	3	D	B	S	L	N		SRV	N	3	
83	CERATOGYMNA (BYCANISTES)	FISTULATOR	SHARPII	E. GUINEA RAINFORESTS	<10,000	4	2	D	B	S	L	N			N	3	
84	CERATOGYMNA (BYCANISTES)	FISTULATOR	DUBOISI	CONGO FORESTS	>10,000	4	1	D	E	S	L	N			N	3	
85	BUCEROS	RHINOCEROS										YES for spp.				3	
86	BUCEROS	RHINOCEROS	RHINOCEROS	MALAYA & SUMATRA	<10,000	4	2 5	D	B	S V	L T	N Y		SRV, TAX	I NUC	3	100+

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
87	BUCEROS	RHINOCEROS	BORNEOENSIS	BORNEO	<2,500	4	1	D+	B	E	L,H T	Y		HSB, SRV, TAX	I	3	100+
88	BUCEROS	RHINOCEROS	SILVESTRIS	JAVA	<500	4	1	D+	A	C	L T	Y	Y	HSB	I	3	8
89	BUCEROS	BICORNIS													I	3	
90	BUCEROS	BICORNIS	BICORNIS	MALAYA & SUMATRA	<2,500	4	2	D	B	E	L T	Y		TAX, HSB	I	3	250+
91	BUCEROS	BICORNIS	HOMRAI	W INDIA TO N MALAYA	<5,000 5,000 -10,000	4	2	D	B	E	L,T,H	Y		TAX, HSB		3	250+
92	BUCEROS	HYDROCORAX													I	3	
93	BUCEROS	HYDROCORAX	HYDROCORAX	LUZON, MARINDUQUE	<2,500	4	2?	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10
94	BUCEROS	HYOROCORAX	SEMIGALEATUS	SAMAR,LEYTE, BOHOL,PANAON	<2,500	4	3	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10
95	BUCEROS	HYDROCORAX	MINOANENSIS	MINDANAO, BASILAN	<2,500	4	1	D	AA	E	L,T,H	Y		SRV	P	3	<10
96	RHINDPLAX	VIGIL		SUNDA SHELF	<10,000	4	3	D+	D	V	L H	Y	Y	SRV	N	3	5
97	BUCORVUS	ABYSSINICUS		GAMBIA TO C. KENYA	?	?	1	S		S	L,H	N	Y	SRV	NUC	?	?
98	BUCORVUS	CAFER (LEADBEATERI)		S. KENYA AND BURUNOI TO S. AFRICA	?	1	1	S		S	L,H	N	Y	SRV	N	?	?

HORNBILL CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

FIRST REVIEW DRAFT

Report from the workshop held
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Singapore

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Compiled by the Workshop Participants

SECTION 3

SPREADSHEETS FOR CRITICAL, ENDANGERED, AND VULNERABLE TAXA

Table 8. CRITICAL HORNBILL TAXA

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
31	PENELOPIDES	PANINI	SUBNIGRA	POLLILO	>250	4	1	D	AA	C	L,H	Y		TAX, SRV	NUC	3	0
33	PENELOPIDES	PANINI	TICAENSIS	TICAO	<2,500	4		D	AA	C	L				NUC	3	
60	RHYTICEROS	LEUCOCEPHALUS	WALDENI	PANAY,NEGROS GUIMARAS	250-5,000		3?	D	AA	C	L,H	Y		SRV, TAX	I		
64	RHYTICEROS	EVERETTI		SUMBA	<250			D+	AA	C	L H	Y	Y		P		
88	BUCEROS	RHINOCEROS	SILVESTRIS	JAVA	<500	4	1	D+	A	C	L T	Y	Y	HSB	I	3	8

Table 9. ENDANGERED HORNBILL TAXA

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	OIFF	NUM
25	PTILOLAEMUS	TICKELLI	TICKELLI	THAILAND BURMA	<2,500	4	1	D	A	E	L	Y		SRV	P	3	0
32	PENELOPIDES	PANINI	MINDORENSIS	MINDORO	<2,500	4		D	AA	E	L,H	Y		TAX, SRV	N	3	0?
36	PENELOPIDES	PANINI	BASILANICA	BASILAN	<250	4	1	D	AA	E	L,H	Y		TAX, SRV	NUC	3	?
40	ACEROS	NIPALENSIS		INDIA, NEPAL TO THAILAND	5-10,000	4	3	D	B	E	L H	Y	Y	SRV	P	3	0
43	ANTHRACOCEROS	CORONATUS	CORONATUS	SRI LANKA	<2,500	4	1	D	AA	E	L	Y	Y	TAX	NUC	3	
50	ANTHRACOCEROS	MARCHEI		PALAWAN ARCH.	250-2500	4		O	AA	E	L,T,H	Y			NUC	3	0?
51	RHYTICEROS	NARCONDAMI		NARCONDAM	<500			S	AA	E	L	Y		TAX	N	3	
87	BUCEROS	RHINOCEROS	BORNEOENSIS	BORNEO	<2,500	4	1	D+	B	E	L,H T	Y		HSB, SRV, TAX	I	3	100+
90	BUCEROS	BICORNIS	BICORNIS	MALAYA & SUMATRA	<2,500	4	2	O	B	E	L T	Y		TAX, HSB	I	3	250+
91	BUCEROS	BICORNIS	HOMRAI	W INDIA TO N MALAYA	<5,000 5,000 -10,000	4	2	D	B	E	L,T,H	Y		TAX, HSB		3	250+
93	BUCEROS	HYDROCORAX	HYDROCORAX	LUZON, MARINOUQUE	<2,500	4	2?	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10

15 February 1994

	TAXON			WILD POPULATION										CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
94	BUCEROS	HYOROCORAX	SEMIGALEATUS	SAMAR,LEYTE, BOHOL,PANAON	<2,500	4	3	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10
95	BUCEROS	HYDROCORAX	MINDANENSIS	MINDANAO, BASILAN	<2,500	4	1	D	AA	E	L,T,H	Y		SRV	P	3	<10

Table 10. VULNERABLE HORNBILL TAXA

	TAXON			WILD POPULATION										CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/öö / HUSB	CAP REC	DIFF	NUM
11	TOCKUS	GRISEUS	GRISEUS	W INDIA	<10,000	4		D	B	V	L	Y	Y	SRV	NUC	3	0
12	TOCKUS	GRISEUS	GINGALENSIS	SRI LANKA	5,000 -10,000	4		D	AA	V	L	Y	Y	SRV	NUC	3	0
23	BERENICORNIS	COMATUS		SUNDA SHELF	5,000 -10,000	4	4	D+	C	V	L,H	N		TAX, SRV	P	3	20+
24	PTILOLAEMUS	TICKELLI			<10,000	4	>2	D	B	V?	L				P	3	
26	PTILOLAEMUS	TICKELLI	AUSTENI	INDIA,BURMA INDOCHINA, THAILAND	<5,000 2,5DD- INDIA	4	3	D+	B A	V E	L,H	Y	Y	SRV	P	3	0
29	PENELOPIDES	PANINI	PANINI	PANAY,NEGROS MASB.,GUIM.	<5,000	4	4	D	AA	V	L,H	Y		TAX, SRV	NUC	3	0
30	PENELOPIDES	PANINI	MANILLOE	LUZON, CATAN, MARINDUQUE	<10,000	4	3	D	AA	V	L,H	Y		TAX, SRV	I	3	50-100
34	PENELOPIDES	PANINI	SAMARENSIS	SAMAR,LEYTE, BOHDL	>10,000	4	3	D	AA	V	L,H	Y		SRV	NUC	3	?
35	PENELOPIDES	PANINI	AFFINIS	MINDANAO, DINAGAT	10,000	4	2	D	AA	V	L,H	Y		TAX, SRV	NUC	3	?
39	PENELOPIDES	EXARHATUS	SANFORDI	S SULAWEZI	<10,000	4	4	D	A	V	L			TAX	N	3	<10
42	ANTHRACOCEROS	CORONATUS	CORONATUS	INOIA	5-10,000	4	2	D	B	V?	L	Y	Y	TAX	N	3	
44	ANTHRACOCEROS	CORONATUS	ALBIROSTRIS	INDIA, BHUTAN TD N MALAYA	>>10,000	4	5?	D	E	V?	L	N	Y	TAX, SRV	NUC	3	8?

	TAXON			WILD POPULATION										CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/öö / HUSB	CAP REC	DIFF	NUM
47	ANTHRACOCEROS	MALAYANUS	MALAYANUS	MALAYA SUMATRA	<5-10,000	4	2	D	C AA	V?	L	N		TAX, SRV	N	3	
48	ANTHRACOCEROS	MALAYANUS	DEMINUTUS SSP.N.	BORNEO	>>10,000	4	1	D	C	V?	L	N		TAX, SRV	NUC	3	
49	ANTHRACOCEROS	MONTANI		SULU ARCHIP.	<2,500	4	2	D	AA	V?	L,H	Y		SRV	NUC	3	?
54	RHYTICEROS	UNDULATUS	AEQUABILIS SSP.N.	BORNEO SABAH	<10,000 2,500-5,000		2	D+	C	V	L,T	N	Y	TAX, SRV	P	3	1+
56	RHYTICEROS	CORRUGATUS	CORRUGATUS	BORNEO	5,000-10,000 <2,500		1	D+	A	V	L,T,H	Y		SRV	P	3	1+
57	RHYTICEROS	CORRUGATUS	RUGOSUS	MALAYA, SUMATRA	2,500-5,000 <2,500		2	D+	B AA	V E	L,T	Y		SRV, TAX	I	3	1+
59	RHYTICEROS	LEUCOCEPHALUS	LEUCOCEPHALUS	MINDANAO, CAMIGUIN	>10,000		2	D	AA	V	L,H	Y		SRV, TAX	I	3	1+
63	RHYTICEROS	CASSIDIX	BREVIROSTRIS	MUNA, BUTON	<2,500		2	D+	AA	V	L	N		SRV, TAX	P	3	
65	RHYTICEROS	SUBRUFICOLLIS		INDIA, BURMA TO SUMATRA	<2,500?		2	D	B	V?	L	Y		TAX,SRV	P	3	
67	RHYTICEROS	PLICATUS	PLICATUS	CERAM, AMBDINA	<10,000		2	D	AA	V	L	N		TAX	N	3	N
70	RHYTICEROS	PLICATUS	DAMPIERI	BISMARK ARCHIPELAGO	<10,000	4	3	D	AA	V	L	N		TAX	N	3	

	TAXON			WILD POPULATION											CAPTIVE PROGRAM			
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/öö / HUSB	CAP REC	DIFF	NUM	
71	RHYTICEROS	PLICATUS	HARTERTI	W SDLOMON IS.	<10,000	4	4	D	AA	V	L	N		TAX	N	3		
72	RHYTICEROS	PLICATUS	MENDANAE	S SOLOMDN IS.	<10,000	4	5	D	AA	V	L	N		TAX	N	3		
73	CERATOGYMNA	ELATA		W. AFRICA - CAMEROON W. TD S. SENEGAL	>10,000	4	3	D	B	V	L,H	Y	Y	SRV	I	3		
96	RHINOPLAX	VIGIL		SUNDA SHELF	<10,000	4	3	D+	D	V	L H	Y	Y	SRV	N	3	5	

HORNBILL CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

FIRST REVIEW DRAFT

Report from the workshop held
24-26 September 1991
Singapore

Edited by
Wendy Worth, Christine Sheppard, Alan Kemp, Susie Ellis, and Ulysses Seal

Working Group Leaders
Carlo Custodio, S. Ainul Hussain, Alan Kemp, Pilai Poonswad, Endang Priyambada

Compiled by the Workshop Participants

SECTION 4

INDIAN SUBCONTINENT TAXA

Table 11. HORNBILL TAXA (Indian Sub-continent)

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
2	TOCKUS	BIRDSTRIS		INDIA	>10,000	4	1	S	E	S	L	N	N			3	0
11	TOCKUS	GRISEUS	GRISEUS	W INDIA	<10,000	4		D	B	V	L	Y	Y	SRV	NUC	3	0
12	TOCKUS	GRISEUS	GINGALENSIS	SRI LANKA	5,000 -10,000	4		D	AA	V	L	Y	Y	SRV	NUC	3	0
26	PTILOLAEMUS	TICKELLI	AUSTENI	INDIA,BURMA INDOCHINA, THAILAND	<5,000 2,500- INDIA	4	3	D+	B A	V E	L,H	Y	Y	SRV	P	3	0
40	ACEROS	NIPALENSIS		INDIA, NEPAL TO THAILAND	5-10,000	4	3	D	B	E	L H	Y	Y	SRV	P	3	0
42	ANTHRACOCERDS	CORONATUS	CORONATUS	INDIA	5-10,000	4	2	D	B	V?	L	Y	Y	TAX	N	3	
44	ANTHRACOCEROS	CORONATUS	ALBIROSTRIS	INDIA, BHUTAN TO N MALAYA	>>10,000	4	5?	D	E	V?	L	N	Y	TAX, SRV	NUC	3	8?
51	RHYTICEROS	NARCONDAMI		NARCONDAM	<500			S	AA	E	L	Y		TAX	N	3	
53	RHYTICEROS	UNDULATUS	UNDULATUS	INDIA TO BALI	>10,000		5	D	B	S	L,T,H	Y N	Y Y	SRV	I NUC	3	1+
65	RHYTICEROS	SUBRUFICOLLIS		INDIA, BURMA TO SUMATRA	<2,500?		2	D	B	V?	L	Y		TAX, SRV	P	3	
91	BUCEROS	BICORNIS	HOMRAI	W INDIA TO N MALAYA	<5,000 5,000 -10,000	4	2	D	B	E	L,T,H	Y		TAX, HSB		3	250+

INDIAN SUBCONTINENT WORKING GROUP TAXON REPORTS
Chair: S. Ainul Hussain

ENDANGERED.

TAXON: Anthrococeros coronatus coronatus

Mace-Lande status: Endangered in India; Vulnerable in Sri Lanka
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Four species in genus; 4 sub-species
Distribution: India and Sri Lanka
Sub-populations: Three in India: Found in pockets along the forested parts in the Western Ghats from below Bombay to Karala. Disjointed population in Eastern Ghats and parts of Southern Orissa. In evergreen and moist deciduous forests of Sri Lanka.
Field studies:: Ph.D. study done on the ecology of this species in India.
Captive status: About 60 individuals in captivity; not identified to sub-species level

CONCERNS/COMMENTS:

1) Habitat in India is fragmented and under pressure from human activities in the evergreen rain forest in the Western Ghats.
2) This same situation is also true for the Eastern Ghats, plus there is some amount of hunting by the local tribals.
3) In Sri Lanka, habitat loss is intense and aggravated by human disturbance.

RECOMMENDATIONS:

Research:: Survey populations; investigate validity of sub-species
Captive programs: Nucleus (in the range country)
PVA: Yes
Other action: Set up viable reserves in the Eastern/Western Ghats

TAXON: Aceros nipalensis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: Not protected
Taxonomic uniqueness: Monotypic genus
Distribution: Central Nepal east to Sikkim, Bhutan, Northeast India, South of Brahmaputra and Chitagong Hill tracts.
Sub-populations: 3
Field studies:: None
Captive status: No captive population
CONCERNS/COMMENTS:

In Nepal, population is declining. Rest of the area, in the wet evergreens and in Terai, are under intense pressure. Population is very low (<5,000 - 10,000).

RECOMMENDATIONS:

Research: no specific recommendation
Field studies: survey
Captive programs: No
PVA: Yes
Other action: no specific recommendation

TAXON: Ptilolaemus tickelli austeni

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Monotypic genus; two sub-species
Distribution: Confined to upper Assam valley of India (range less than 50,000 sq km).
Sub-populations: ?
Field studies: None
Captive status: None known in captivity
CONCERNS/COMMENTS:

Very small range; adjacent areas are under intense pressures. Highly endangered.

RECOMMENDATIONS:

Research: Study ecology, population size
Captive Programs: Nucleus; identify related species to serve as model for development of captive propagation program
PVA: Yes
Other action: Protect range habitat; identify ways to promote species and habitat conservation to local inhabitants

TAXON: Rhyticeros narcondami

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: Endangered
Local: not protected
Taxonomic uniqueness: Eight species in genus
Distribution: Narcondam island (<15 sq km).
Sub-populations: No
Field studies:: Some aspects of biology and ecology currently under investigation; published reports by S. Hussain
Captive status: None in captivity

CONCERNS/COMMENTS:

Habitat alteration by feral goats, natural calamity (including volcanic activity) and impact of small human presence are all concerns; small range means population has very little resistance to threat.

RECOMMENDATIONS:

Research: Continue work on ecology of species, especially feeding and nesting requirements; investigate taxonomic relationships; determine if range of species was ever more extensive
Captive programs: No; not until protocols developed for more common species
PVA: Yes
Other action: Remove goats from Narcondam Island; declare island a Hornbill reserve?

TAXON: Buceros bicornis homrai

Mace-Lande status: Endangered
CITES: Appendix I
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: There is evidence that this may not be a valid sub-species; current taxonomy: 3 species in genus; 2 sub-species
Distribution: Western Ghats, Northeast India, Bhutan and evergreen forest
Sub-populations: 3?
Field studies:: Ph.D. thesis study has been initiated in S. India
Captive status: Species is one of most common in zoos; international studbook kept by Wendy Worth, San Antonio Zoo. Much of the work on captive propagation is based on this species.

CONCERNS/COMMENTS:

Logging and other pressures are degrading habitat; the species is under intense human pressure. The south and northeast populations are endangered.

RECOMMENDATIONS:

Research: Complete review of sub-species validity (Amado, New York Zoological Society); Survey; Husbandry

Captive programs: No; intense efforts should be made to develop reliable, transferable husbandry guidelines; Indian zoo populations should be surveyed and breeding programs developed.

PVA: Yes

Other action: no specific recommendations

TAXON: Tockus griseus griseus

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two Asian species in genus; 2 sub-species
Distribution: SW India (Western Ghats), tropical evergreen to moist deciduous forests
Sub-populations: Unknown
Field studies:: None known
Captive status: Few in captivity
CONCERNS/COMMENTS:
Habitat loss throughout the range is a concern.
RECOMMENDATIONS:

Research: Survey to develop better estimate of population size
Captive programs: Nucleus. Note: considerable information exists concerning propagation of African *Tockus* species; recommend investigation of ecological similarities and whether existing techniques work for this species.
PVA: Yes
Other action: Protect existing habitat

TAXON: Tocus griseus gingalensis

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: one of two sub-species
Distribution: Restricted distribution in Sri Lanka
Sub-populations: Unknown
Field studies: None
Captive status: No captive population
CONCERNS/COMMENTS:

Loss of habitat and other human caused habitat disturbance is a problem.

RECOMMENDATIONS:

Research: Survey to determine population numbers and status
Captive programs: Nucleus
PVA: Yes
Other action: Protect habitat

TAXON: Anthrococeros coronatus albirostrus
Mace-Lande status: Vulnerable?
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Four species in genus; 3 sub-species
Distribution: Nepal, east to Bhutan and NE INdia. Subpopulations in the Eastern Ghats of India need to be investigated taxonomically.
Sub-populations: 5?
Field studies:: None
Captive status: There are a few birds in captive collections (<10).
CONCERNS/COMMENTS:

Habitat loss and hunting pressure are threats to this species.

RECOMMENDATIONS:

Research: Taxonomic status of this species needs to be clarified; need surveys of population size and ecology
Captive programs: Nucleus
PVA: Yes, as part of PHVA for Indian hornbills
Other action: No specific recommendations

TAXON: Rhyticeros subruficollis

Mace-Lande status: Vulnerable?
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Eight species in genus; no sub-species
Distribution: NE India, possibly Burma
Sub-populations: 2
Field studies:: None
Captive status: Not known
CONCERNS/COMMENTS:

Very little is known about the taxonomic relationships of this species. More studies on wild populations are needed to resolve taxonomic questions.

RECOMMENDATIONS:

Research: Taxonomic work, population surveys
Captive programs: Pending; recommendation following PVA
PVA: YES
Other action: No specific recommendations

SECURE.

TAXON: Rhyticeros undulatus undulatus

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: NE India, Bhutan, Bangladesh
Sub-populations: 5
Field studies:: None
Captive status: More than 100 in captivity
CONCERNS/COMMENTS:

Habitat is under pressure throughout range; hunting by local inhabitants may be significant

RECOMMENDATIONS:

Research: No specific recommendations

Captive programs: The captive populations of this species should be used to develop husbandry protocols for other large Asian Hornbills

PVA: Yes

Other action: Develop alternatives for local use of Hornbills for food (and feathers?)

TAXON: Tockus birostris

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two Asian species in genus
Distribution: Throughout India, except in Himalayas and desert areas
Sub-populations: ?
Field studies: Unaware of specific efforts
Captive status: Not known
CONCERNS/COMMENTS:

Most common Indian hornbill species; no immediate threat

RECOMMENDATIONS:

Research: Not a priority

Captive Programs: See if propagation methods for African *Tocus* species can be generalized; this species could be a good way to introduce Indian zoos to Hornbill propagation

PVA: No

Other action: No specific recommendations

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Compiled by the Workshop Participants

SECTION 5

PHILIPPINE TAXA

Table 12. HORNBILL TAXA (Philippines)

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
29	PENELOPIDES	PANINI	PANINI	PANAY,NEGROS MASB.,GUIM.	<5,000	4	4	D	AA	V	L,H	Y		TAX, SRV	NUC	3	0
30	PENELOPIDES	PANINI	MANILLOE	LUZON, CATAN, MARINDUQUE	<10,000	4	3	D	AA	V	L,H	Y		TAX, SRV	I	3	50-100
31	PENELOPIDES	PANINI	SUBNIGRA	POLLILO	>250	4	1	D	AA	C	L,H	Y		TAX, SRV	NUC	3	0
32	PENELOPIDES	PANINI	MINDORENSIS	MINDORO	<2,500	4		D	AA	E	L,H	Y		TAX, SRV	N	3	0?
33	PENELOPIDES	PANINI	TICAENSIS	TICAD	<2,500	4		D	AA	C	L				NUC	3	
34	PENELOPIDES	PANINI	SAMARENSIS	SAMAR,LEYTE, BOHOL	>10,000	4	3	D	AA	V	L,H	Y		SRV	NUC	3	?
35	PENELOPIDES	PANINI	AFFINIS	MINDANAO, DINAGAT	10,000	4	2	D	AA	V	L,H	Y		TAX, SRV	NUC	3	?
36	PENELOPIDES	PANINI	BASILANICA	BASILAN	<250	4	1	D	AA	E	L,H	Y		TAX, SRV	NUC	3	?
49	ANTHRACOCERDS	MONTANI		SULU ARCHIP.	<2,500	4	2	D	AA	V?	L,H	Y		SRV	NUC	3	?
50	ANTHRACOCEROS	MARCHEI		PALAWAN ARCH.	250-2500	4		D	AA	E	L,T,H	Y			NUC	3	0?

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
59	RHYTICEROS	LEUCOCEPHALUS	LEUCOCEPHALUS	MINDANAO, CAMIGUIN	>10,000		2	D	AA	V	L,H	Y		SRV, TAX	I	3	1+
60	RHYTICEROS	LEUCOCEPHALUS	WALDENI	PANAY,NEGROS GUIMARAS	250-5,000		3?	D	AA	C	L,H	Y		SRV, TAX	P	3	
93	BUCEROS	HYDROCORAX	HYDROCDRAX	LUZON, MARINDUQUE	<2,500	4	2?	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10
94	BUCEROS	HYDROCORAX	SEMIGALEATUS	SAMAR,LEYTE, BOHOL,PANAON	<2,500	4	3	D	AA	E	L,T,H	Y		SRV, TAX	I	3	<10
95	BUCEROS	HYDROCORAX	MINDANENSIS	MINDANAO, BASILAN	<2,500	4	1	D	AA	E	L,T,H	Y		SRV	P	3	<10

PHILIPPINE WORKING GROUP
Chair: Carlo Custodio

CRITICAL.
TAXON: Penelopides panini ticaensis

Mace-Lande status: Critical
CITES: Appendix II
IUCN Red Data Book: not listed
Local: Appendix II
Taxonomic uniqueness: two species in genus; eight sub-species
Distribution: Ticao
Sub-populations: none
Field studies:: none
Captive status: none recorded
CONCERNS/COMMENTS:

Probably extinct. Need confirmation.

RECOMMENDATIONS::

Research: priority low; survey to confirm extinction; use museum specimens to define differences from other subspecies
Captive Programs: Nucleus. Any in captivity should immediately be placed in management situation
PVA: yes, for species

TAXON: Penelopides panini subnigra

Mace-Lande status: Critical
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two species in genus; 8 sub-species
Distribution: Polillo
Field studies: none known
CONCERNS/COMMENTS:

This sub-species may already be extinct; if any birds remain, they are very vulnerable as this island is in a typhoon zone. The sub-species may not be distinct from *P.p. manilloe*.

RECOMMENDATIONS::

Research: Survey or other action to discover whether or not a population still exists. Genetic work to determine whether or not this is a true sub-species
Captive programs: Nucleus. There may be birds in captive situations, especially locally; if so, the Intensive program recommended.
PVA: yes, for species **Other action:** No specific recommendations.

TAXON: Rhyticeros leucocephalus waldeni

Mace-Lande status: Critical
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Probably true species; currently 8 species in genus, two sub-species
Distribution: Panay, Guimaras, Negros
Field studies:: see *P. p. panini* for Panay and Negros; none known for Guimaras
CONCERNS/COMMENTS:
Guimaras has no forest; see *P. p. panini.*
RECOMMENDATIONS::

Research: check Cambridge University team's results; seek to contact anyone who could provide further data urgently both on specific status and on wild status (e.g. Mila Abreo with the DNR, based on Panay in Ilo Iilo City); otherwise see *P. p. panini.*
Captive Programs: Intensive program needed. None known in captivity; may be in trade.
PVA: yes
Other action: No specific recommendations.

ENDANGERED.

TAXON: Anthracoceros marchei

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: Entire range is designated wildlife reserve; two parks within range (El Nido, St. Paul's Subterranean River) offer additional protection; this is not enforced.
Taxonomic uniqueness: one of four species in genus
Distribution: Palawan Archipelago
Field studies:: No existing/current field studies. N. Collar has undisclosed source who has wild data. **Captive status:** A few in collections. Check deDios in Manila. International Animal Exchange offered a few within the last few years.

CONCERNS/COMMENTS:

Palawan is a biological hot-spot. Work there could center on more than just one species. Could do a PHVA on the entire area's biota. The human population there is rapidly expanding and in the northern part of the species range four islands (Busuanga, Culion, Balabac and Linapacahan) have been totally deforested. The area is legally a reserve, with parks within the area providing additional
protection on paper.

RECOMMENDATIONS::

Research: Survey population size and distribution
Captive Programs: Nucleus. Primary recommendation is to use existing captive congeners to establish husbandry protocols.
PVA: Yes, for entire area.
Other action: Develop management strategies based on existing protection. Identify alternate ways for human population to obtain needed resources.

TAXON: Penelopides panini basilanica

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two species in genus; eight sub-species
Distribution: Basilan
Field studies:: none known
CONCERNS/COMMENTS:

Basilan has very little forest remaining; even the one protected area is settled.

RECOMMENDATIONS:

Research: Survey any remaining population: confirm taxonomic distinctiveness.
Captive Programs: Nucleus; none known in captivity.
PVA: yes, for genus
Other action: No specific recommendations.

TAXON: Penelopides panini mindorensis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: no protection
Taxonomic uniqueness: Two species in genus; eight sub-species
Distribution: Mindoro (Philippines)
Field studies:: Cambridge University Expedition 1991 (Tom Evans) conducted general surveys of protected areas under Jensen's direction.
Captive status: none known
CONCERNS/COMMENTS:

Mindoro probably has only 20% forest cover now, although very little further extraction is planned. There are two parks, Iglid Baco National Park, which is partially forested and is a reserve for tamarau; Mount Halcon, in the area with most of the remaining forest on the island.

RECOMMENDATIONS:

Research: Verify the existence of current survey information.
Captive programs: No program recommended. Check the existence of any in captivity.
PVA: Yes, for the genus
Other action: No specific recommendations.

TAXON: Buceros hydrocorax hydrocorax

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: May deserve to be listed as full species; currently 3 species; 3 sub-species
Distribution: Luzon, Marinduque
Field studies:: see *P. p. manilloe*
CONCERNS/COMMENTS:

Kemp says *B. hydrocorax hydrocorax* is a good species; this needs to be investigated along with a review of distinctness of the other two races; attractive and likely traded in some volume, at least locally, probably meaning loss of nest trees; being bigger, population may be relatively smaller; Witmer's evidence is that this form is a cooperative breeder, which has implications for captive management. Complete review of sub-species validity is being conducted by Amado, New York Zoological Society).

RECOMMENDATIONS:

Research: Investigate taxonomy

Captive Programs: Intensive; none known in captivity; need to develop husbandry techniques

PVA: yes

Other action: No specific recommendations.

TAXON: Buceros hydrocorax semigaleatus
Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: possibly a full species; currently 3 species in genus; 3 sub-species
Distribution: Samar, Leyte, Bohol and Panaon
Field studies:: see *P. p. samarensis*
CONCERNS/COMMENTS:

Attractive and likely traded in some volume (probably meaning loss of nest trees). This is a large species, so a given area will support small populations compared to other species. Complete review of sub-species validity is being conducted by Amado, New York Zoological Society).

RECOMMENDATIONS:

see *P. p. samarensis*
Research: Verify taxonomic status
Captive Programs: Intensive. Fewer than ten are listed in captive collections, but many more probably exist. Location of captive birds should be identified. Husbandry techniques should be developed.
PVA: yes
Other action: Improve protection for existing parks. Identify local individuals with skills in captive husbandry.

TAXON: Buceros hydrocorax mindanensis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: possibly a species; now 3 species in genus; 3 sub-species
Distribution: Mindanao, Basilan
Field studies:: see *P. p. affinis* and *basilanicus*
CONCERNS/COMMENTS:
see other *B. hydrocorax* entries
RECOMMENDATIONS:
see other *B. hydrocorax* entries and *P. p. affinis* and *basilanicus*
Research:

Captive Programs: Pending; see other *B. hydrocorax* entries
PVA: yes
Other action: No specific recommedations.

VULNERABLE.

TAXON: Anthracoceros montani

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not listed
Taxonomic uniqueness: one of four species in genus
Distribution: Sulu Archipelago: Jolu Sulu and Tawi Tawi
Sub-populations: 2
Field studies:: No known field studies. Dr. Frank Lambert has been working in the area on the red- vented cockatoo, and could have some information on Sulu hornbill also.
Captive status: None in captivity, unless some held by local inhabitants; this number probably insignificant.

CONCERNS/COMMENTS:

There is no logging on these islands now; the habitat is fair to poor, with continued local use of forest resources. The area is one of political conflict and the trend is for people to leave, so the population is not increasing. The hornbill is not much hunted for food. This species is listed as threatened in Birds to Watch. There is local trade by sea with Sabah. If the species ever becomes attractive to trade, this route would make protection difficult, because of the ease of smuggling.

RECOMMENDATIONS:

Research: Survey
Captive Programs: Nucleus. Primary recommendation is to use existing captive congeners to establish husbandry protocols.
PVA: Yes
Other action: Use survey and other information to designate areas to be protected. Investigate status of existing national park, Mount Dajo, in Sulu and if the species exists there, could the area be a hornbill reserve.

TAXON: Penelopides panini panini

Mace Lande status: Vulnerable
CITES: - Appendix II
IUCN Red Data Book: - not listed
Local: No information available.
Taxonomic uniqueness: two species in genus; eight sub-species
Distribution: Islands of Panay, Negros (historically also Masbate, Guimaras)
Field studies:: field survey 1991 by Cambridge University Expedition (see P. p. mindorensis)
Captive status: none recorded

GENERAL COMMENT FOR ALL Penelopides panini subspecies:

Penelopides panini manilloe has bred in captivity many times. Indications are that the birds breed well but take quite a long time to learn to be successful parents. It might be worth developing techniques for hand-rearing or supplementing parent-reared chicks, to provide the potential of rapid population increase, if a rare species needs rescue. However, it is already difficult to place offspring with other institutions.

CONCERNS/COMMENTS:

No forest is left on Masbate (now a cattle ranch) and Guimaras. Negros and Panay have some forest (10-20%, 30% respectively) left. Logging continues. This sub-species is particularly close to *P. p. ticaensis*. Canlaon National Park is listed on Negros. On Panay, a proposed national park, called Mt. Baloy, is to be created to protect the spotted deer; the hornbill may gain some added protection vicariously.

RECOMMENDATIONS:

Research: Contact Bill Oliver, spotted deer researcher, to see whether he would be willing to undertake a hornbill survey as well. Lawrence Heaney (Field Museum) and Roger Cox (WWF-Vietnam), also Bob Kennedy, could be of help.
Captive Programs: Nucleus
PVA: yes, for genus
Other action: No specific recommendation.

TAXON: Penelopides panini manilloe

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two species in genus; eight sub-species
Distribution: Islands of Luzon, Marinduque, Catanduanes; also a few small, unlisted islets
Sub-populations: 2
Field studies:: There is an ongoing ICBP project in the north of Luzon. Contact Bob Kennedy and Mark Witmer (Cornell), Steve Goodman (Field Museum); Arne Jensen.
Captive status: Probably 50 - 100 in collections.

CONCERNS/COMMENTS:

Luzon has a substantial amount of remaining forest, as well as some disjunct forest on mountain peaks. Marinduque probably has little forest. Catanduanes probably has little forest. Status on small islands unknown. Volcanic activity from Mt. Pinatubo may have impacted part of the population. Logging is a major threat. There is a proposal to build major road cutting though most important remaining forest area.

RECOMMENDATIONS:

Research: Survey population numbers, determine relationships between sub-populations
Captive Programs: Intensive. This sub-species can serve as a model for more threatened relatives
PVA: yes, for species
Other action: Influence government to stop construction of new road.

TAXON: Penelopides panini samarensis

Mace-Lande status: Vulnerable
CITES: Appendix II
Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two species in genus; eight sub-species
Distribution: Samar, Leyte, Bohol
Sub-populations: 3
Field studies:: Heaney (Field Museum) has worked on Leyte
CONCERNS/COMMENTS:

Forest cover: Samar 30% remaining cover, still logging; Leyte 20% remaining cover; Bohol 10% cover remains; logging has been discontinued here. Remaining trees are within Raja Sikatuna National Park. There may be parks on the other islands but this needs checking. At present, parks provide little protection for wildlife.

RECOMMENDATIONS:

Research: Quantify existing populations
Captive Programs: Nucleus; none currently known in captivity.
PVA: yes, for genus
Other action: Improve protection and enforcement in existing parks.

TAXON: Penelopides panini affinis

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Two species in genus; eight sub-species
Distribution: Mindanao, Dinagat
Field studies:: Eagle group or past workers (Kennedy, Witmer) may have data
CONCERNS/COMMENTS:

Dinagat is very small and has little forest; some birds may survive; Mindanao may have as much as 40% cover, but logging continues; protected areas include Mt. Apo, Mt. Malindang, and Mt. Kitanglad

RECOMMENDATIONS:

Research: survey work; determine distinctiveness of related taxa
Captive programs: Nucleus; none currently known in captivity.
PVA: yes, for genus
Other action: Develop plan to increase protection for protected areas.

TAXON: Rhyticeros leucocephalus leucocephalus

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: listed as one of two sub-species; other sub-species is extinct or close to extinction. Kemp believes both should be accorded full species status.
Distribution: Mindanao, Camiguin
Field studies:: for Mindanao see *Penelopides panini affinis*; none known for Camiguin
CONCERNS/COMMENTS:

This bird may deserve full species status; there is very little forest remaining on Camiguin.

RECOMMENDATIONS:

Research: Use molecular techniques to confirm taxonomic status.
Captive Programs: Nucleus. About ten birds known in collections; the species has bred in captivity.
PVA: Yes
Other action: No specific recommendations.

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Compiled by the Workshop Participants

SECTION 6

SOUTHEAST ASIAN TAXA

Table 13. HORNBILL TAXA (Southeast Asia)

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
23	BERENICORNIS	COMATUS		SUNDA SHELF	5,000 -10,000	4	4	D+	C	V	L,H	N		TAX, SRV	P	3	20+
25	PTILDLAEMUS	TICKELLI	TICKELLI	THAILAND BURMA	<2,500	4	1	D	A	E	L	Y		SRV	P	3	0
26	PTILOLAEMUS	TICKELLI	AUSTENI	INDIA,BURMA INDDCHINA, THAILAND	<5,000 2,500- INDIA	4	3	D+	B A	V E	L,H	Y	Y	SRV	P	3	0
40	ACEROS	NIPALENSIS		INDIA, NEPAL TD THAILAND	5-10,000	4	3	D	B	E	L H	Y	Y	SRV	P	3	0
44	ANTHRACDCEROS	CORONATUS	ALBIROSTRIS	INDIA, BHUTAN TO N MALAYA	>>10,000	4	5?	D	E	V?	L	N	Y	TAX, SRV	NUC	3	8?
53	RHYTICEROS	UNDULATUS	UNDULATUS	INDIA TO BALI	>10,000		5	D	B	S	L,T,H	Y N	Y Y	SRV	I NUC	3	1+
86	BUCEROS	RHINOCEROS	RHINOCEROS	MALAYA & SUMATRA	<10,000	4	2 5	D	B	S V	L T	N Y		SRV, TAX	I NUC	3	100+
90	BUCEROS	BICORNIS	BICDRNIS	MALAYA & SUMATRA	<2,500	4	2	D	B	E	L T	Y		TAX, HSB	I	3	250+
96	RHINOPLAX	VIGIL		SUNDA SHELF	<10,000	4	3	D+	D	V	L H	Y	Y	SRV	N	3	5

SOUTHEAST ASIA MAINLAND WORKING GROUP
Chair: Pilai Poonswad

ENDANGERED.

TAXON: Aceros nipalensis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: Threatened
Local: not protected
taxonomic uniqueness: Monotypic genus
Distribution: India to Thailand, Vietnam, S. China, S. Laos
Sub-populations: 3
Field studies: Two nests under study in Thailand
Captive status: Not known
CONCERNS/COMMENTS:

Endangered in Thailand (about 500 remain); extinct in Nepal; hunted for food in Vietnam.

RECOMMENDATIONS:

Research: Survey population size and distribution
Captive programs: Pending. Work with surrogate species.
PVA: yes
Other action: Develop alternate, cheap protein sources for people in region.

TAXON: Ptilolaemus tickelli tickelli

Mace-Lande status: Endangered
CITES: not listed
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: Monotypic genus; one of two sub-species
Distribution: Thailand and Burma
Sub-populations: 1
Field studies: in Thailand; Poonswad
Captive status: < 10 in captivity
CONCERNS/COMMENTS:

Does not occur on southern plains; co-operative breeder with only male helpers. Martens are main predators. Endangered in Thailand.

RECOMMENDATIONS:

Research: Survey
Captive programs: Pending. Work with surrogates; captive program recommended only if PHVA indicates necessary.
PVA: yes **Other action:** Improve protection in reserve areas.

TAXON: Buceros bicornis bicornis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: Three species in genus; 2 sub-species
Distribution: Thailand, Malaya, Sumatra
Sub-populations: 2
Field studies: Poonswad, in Thailand: long term population dynamics and ecological studies; radio telemetry, diet, nesting habits; Leighton work on population dynamics in Borneo.
Captive status: Probably most common and most commonly bred hornbill in captivity. International studbook kept by W. Worth, San Antonio Zoo; EEP initiated in Europe by Koen Brouwer.
CONCERNS/COMMENTS: No specific concerns.
RECOMMENDATIONS:

Research: Determine validity of sub-species; preliminary evidence is against distinct sub-species.
Captive programs: Intensive. Identify sub-species, if necessary. Develop good management protocols and prepare documentation.
PVA: Yes
Other action: No specific recommendations.

VULNERABLE.

TAXON: Anthracoceros coronatus albirostris

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Four species in genus; one of four sub-species
Distribution: India to N. Malaya
Sub-populations: 5?
Field studies: Thailand, P. Poonswad
Captive status: Captive population <100, for sub-species combined

CONCERNS/COMMENTS:

This taxon would be a good model for developing captive protocols for other species; might be good candidate for experimenting with artificial nest boxes. Good candidate for re-introduction?

RECOMMENDATIONS:

Research: Survey population size and distribution; determine validity of described sub-species
Captive programs: Nucleus. Identify sub-species in captive population.
PVA: Not required
Other action: No specific recommendations.

TAXON: Birenicornis comatus

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
Taxonomic uniqueness: Monotypic genus
Distribution: Sunda shelf, Thailand, Vietnam, Sabah
Sub-populations: 4
Field studies: Some work done in Thailand; see Poonswad
Captive status: Small captive population (<30); bred in 1991 at Walsrode
CONCERNS/COMMENTS:

Endangered in Thailand; second rarest species in Malaysia; cooperative breeder

RECOMMENDATIONS:

Research: Resolve question of monotypic genus
Captive programs: Nucleus
PVA: Not required
Other action: No specific recommendations.

TAXON: Ptilolaemus tickelli austeni

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: May deserve full species status? Current taxonomy: Monotypic genus; 2 sub-species
Distribution: India, Burma, Thailand, Indochina
Sub-populations: 3
Field studies: in Thailand: Poonswad
Captive status: Two known in captivity
CONCERNS/COMMENTS:

Does not appear to occur sympatrically (with *P. t. tickelli*). Less than 2500 in India. The population in Khao Yai, Thailand, is isolated.

RECOMMENDATIONS:

Research: Clarify taxonomy; survey
Captive programs: Pending.
PVA: Yes
Other action: Increase protection of reserves e.g., Khao Yai

TAXON: Rhinoplax vigil

Mace-Lande status: Vulnerable
CITES: Appendix I
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: Monotypic genus; distinct
Distribution: Sunda shelf
Sub-populations: 3
Field studies: preliminary study in Thailand
Captive status: 5 known in collections
CONCERNS/COMMENTS:

Endangered in Thailand; Threatened by hunting for Hornbill "ivory" and by habitat destruction.

RECOMMENDATIONS:

Research: Survey; study ecology and breeding behavior
Captive programs: Pending.
PVA: Yes
Other action: Alternatives for ivory?

SECURE.

TAXON: Rhyticeros undulatus undulatus

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: India to Bali
Sub-populations: 5
Field studies: Thailand: Poonswad
Captive status: Combined captive population of all sub-species over 100. Has been bred in captivity.
CONCERNS/COMMENTS:

Birds are hunted in India.

RECOMMENDATIONS:

Research: Survey
Captive programs: Nucleus. Improve breeding protocols, get all birds into breeding situations.
PVA: Yes **Other action:** No specific recommendations.

TAXON: Buceros rhinoceros rhinoceros

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: not protected
taxonomic uniqueness: Three species in genus; 3 sub-species
Distribution: S. Thailand, Malaya, Sumatra
Sub-populations: 7?
Field studies: None
Captive status: One of most common zoo species. Studbook kept by W. Worth, San Antonio. Has been bred in captivity.

CONCERNS/COMMENTS:

Endangered in Thailand; Sumatra population indeterminate.

RECOMMENDATIONS:

Research: Determine validity of sub-species; survey population distribution and size
Captive programs: Nucleus. Good model species for other large Asian hornbills; strenuous efforts should be made to develop propagation protocols.
PVA: Yes
Other action: No specific recommendations.

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Compiled by the Workshop Participants

SECTION 7

INDONESIAN TAXA

Table 14. HORNBILL TAXA (Indonesia)

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
27	ANDRRHINUS	GALERITUS		SUNDA SHELF VIETNAM?	>10,000	4	3	D-	D	S	L H	N		SRV	N	3	10+
38	PENELOPIDES	EXARHATUS	EXARHATUS	N SULAWEZI	>10,000	4	2	D	B	S	L	P		TAX, SRV	P	3	<10
39	PENELOPIDES	EXARHATUS	SANFORDI	S SULAWEZI	<10,000	4	4	D	A	V	L			TAX	N	3	<10
45	ANTHRACOCEROS	CORONATUS	CDNVEXUS	MALAYA TO BALI	>10,000	4	30	D-	D	S	L	N		TAX	NUC	3	10?
47	ANTHRACOCEROS	MALAYANUS	MALAYANUS	MALAYA SUMATRA	<5-10,000	4	2	D	C AA	V?	L	N		TAX, SRV	N	3	
48	ANTHRACOCERDS	MALAYANUS	DEMINUTUS SSP.N.	BORNEO	>>10,000	4	1	D	C	V?	L	N		TAX, SRV	NUC	3	
54	RHYTICERDS	UNDULATUS	AEQUABILIS SSP.N.	BORNED SABAH	<10,000 2,500-5,000		2	D+	C	V	L,T	N	Y	TAX, SRV	P	3	1+
56	RHYTICERDS	CORRUGATUS	CORRUGATUS	BORNEO	5,000-10,000 <2,500		1	D+	A	V	L,T,H	Y		SRV	P	3	1+
57	RHYTICEROS	CDRRUGATUS	RUGOSUS	MALAYA, SUMATRA	2,500-5,000 <2,500		2	D+	B AA	V E	L,T	Y		SRV, TAX	I	3	1+
62	RHYTICEROS	CASSIDIX	CASSIDIX	SULAWEZI	>10,000		4	D	B	S	L	N		SRV, TAX	I	3	5
63	RHYTICEROS	CASSIDIX	BREVIROSTRIS	MUNA, BUTON	<2,500		2	D+	AA	V	L	N		SRV, TAX	P	3	

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
64	RHYTICEROS	EVERETTI		SUMBA	<250			D+	AA	C	L H	Y					
69	RHYTICEROS	PLICATUS	JUNGEI	E NEW GUINEA	>10,000	4		D	C	S	L	N		TAX	N	3	
70	RHYTICERDS	PLICATUS	DAMPIERI	BISMARK ARCHIPELAGO	<10,000	4	3	D	AA	V	L	N		TAX	N	3	
71	RHYTICEROS	PLICATUS	HARTERTI	W SOLOMDN IS.	<10,000	4	4	D	AA	V	L	N		TAX	N	3	
72	RHYTICEROS	PLICATUS	MENDANAE	S SOLOMON IS.	<10,000	4	5	D	AA	V	L	N		TAX	N	3	
87	BUCEROS	RHINOCERDS	BORNEOENSIS	BORNEO	<2,500	4	1	D+	B	E	L,H T	Y		HSB, SRV, TAX	I	3	100+
88	BUCEROS	RHINOCEROS	SILVESTRIS	JAVA	<500	4	1	D+	A	C	L T	Y	Y	HSB	I	3	8

INDONESIAN WORKING GROUP
Chair: Endang Priyambada

CRITICAL.

TAXON: Buceros rhinoceros silvestris

Mace-Lande status: Critical
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Three species in genus; 3 sub-species
Distribution: Remnant forest in Java
Sub-populations: 1
Field studies: None known
Captive status:: 25-50; over 100 for all sub-species; North American studbook kept by W. Worth, San Antonio Zoo.

CONCERNS/COMMENTS:

Habitat declining fast, almost gone except a few reserves; population size very small (<500), and declining.

RECOMMENDATIONS:

Research: Population/distribution survey needed; Husbandry research also
Captive Programs: Intensive; need intensive work on development of captive breeding protocols
PVA: Yes
Other action: No specific recommendations.

TAXON: Rhyticeros everetti

Mace-Lande status: Critical
CITES: Appendix II
IUCN Red Data Book: Endangered
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus
Distribution: Sumba island
Sub-populations: none
Field studies: Forest survey -- University of Manchester; proposed additional survey.
Captive status:: None known

CONCERNS/COMMENTS:

Fewer than 200 birds in the wild, numbers declining fast. Semi-arid habitat very fragile, human activity intense.

RECOMMENDATIONS:

Research: Population/distribution studies needed; also nest site and feeding requirements, determine limiting factors in remaining habitat.
Captive programs: Pending. Not until protocols developed for surrogate species.
PVA: Yes, for ecosystem
Other action: Develop strategies for protecting ecosystem; involve local inhabitants in conserving watershed; look at ways of supporting wild population -- food trees, nest cavities

ENDANGERED.

TAXON: Buceros rhinoceros borneoensis

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: Not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Three species in genus; 3 sub-species
Distribution: Borneo
Sub-populations: 1
Field studies: None known
Captive status: One of more popular zoo species; North American studbook kept by W. Worth, San Antonio. Species has been bred, more work needed to develop repeatable protocols.
CONCERNS/COMMENTS:

Declining fast; wild numbers <2,500. Birds are hunted for cultural reasons.

RECOMMENDATIONS:

Research: Clarify validity of sub-species; population surveys, especially in Sumatra.
Captive programs: Intensive. Work needed on improving captive breeding protocols. Also, efforts should be made to locate all captive specimens and bring them into captive breeding situations.
PVA: Yes
Other action: Develop alternatives to replace cultural uses of species.

TAXON: Rhyticeros corrugatus rugosus

Mace-Lande status: Endangered
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: Peninsular Malaysia, Sumatra
Sub-populations: 2
Field studies: None known
Captive status:: >10; 50-100 for all sub-species

CONCERNS/COMMENTS:

Large numbers collected for trade in late 1980's. Very rare in Peninsular Malaysia.

RECOMMENDATIONS:

Research: Taxonomic studies needed to clarify sub-species; population and distribution surveys needed.

Captive programs: Intensive. Need to locate captive specimens not in breeding programs; need to work on captive management protocols.

PVA: Yes

Other action: No specific recommendations.

VULNERABLE.

TAXON: Anthracoceros malayanus malayanus

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Four species in genus; 2 sub-species
Distribution: Peninsular Malaysia, Sumatra
Sub-populations: 2
Field studies: None known
Captive status:: > 16 for both sub-species combined

CONCERNS/COMMENTS:

Numbers declining and habitat disturbed. However, this taxon is thought to show more adaptive flexibility than other hornbills. Feed in oil palm plantations. W. Sumatran population under greater threat than others.

RECOMMENDATIONS:

Research: Need surveys of population distribution and size
Captive programs: Nucleus. Use as surrogate species?
PVA: Only as part of PVA for region
Other action: No specific recommendations.

TAXON: Penelopides exarhatus sanfordi

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Two species in genus; 2 sub-species
Distribution: Southern Sulawesi
Sub-populations: 4
Field studies: Refer to Rene Dekker, recent survey (KUKILOR); refer to Derek Holmes
Captive status:: No significant captive population

CONCERNS/COMMENTS:

Threatened by loss of habitat. S. Sulawesi is more developed than the north and population there is more fragmented and subdivided.

RECOMMENDATIONS:

Research: Verify subspecies relationships; need surveys of population distribution and size
Captive programs: Not required at present. No recommendation.
PVA: Not required at present
Other action: No specific recommendation.

TAXON: Rhyticeros corrugatus corrugatus

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: Borneo and its islands
Sub-populations: 1
Field studies: None known
Captive status:: 70 known for combined sub-species
CONCERNS/COMMENTS:

Population undergoing rapid decline, 5-10,000 in the wild

RECOMMENDATIONS:

Research: Taxonomic work on validity of sub-species; survey of population distribution and size
Captive programs: Pending.
PVA: Yes
Other action: No specific recommendations.

TAXON: Rhyticeros cassidix brevirostris

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: Muna, Buton
Sub-populations: 2
Field studies: None known
Captive status:: None known (see *R. c. cassidix*)
CONCERNS/COMMENTS:

No specific concerns.

RECOMMENDATIONS:

Research: Verify taxonomic relationships, especially sub-species. Field surveys of population distribution and size.
Captive programs: Pending.
PVA: Not required at present **Other action:** No specific recommendations.

TAXON: Rhyticeros undulatus aequabilis

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: Borneo
Sub-populations: 2
Field studies: None known
Captive status:: 100-125 for combined sub-species; none known for this sub-species.

CONCERNS/COMMENTS:

Is this population sufficiently isolated to be a separate species?

RECOMMENDATIONS:

Research: Verify status as species or sub-species; survey population size and distribution
Captive programs: Pending
PVA: Yes
Other action: No specific recommendations.

TAXON: Rhyticeros plicatus subspecies, including plicatus, ruficollis, jungei, dampieri, harterti, mendanae

Mace-Lande status: Vulnerable
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 6 subspecies
Distribution: New Guinea and Melanesia
Sub-populations: probably many
Field studies: None known
Captive status:: 50-100 for combined subspecies
CONCERNS/COMMENTS:

Very little known. Taxonomic work needs to be carried out to clarify relationships. Considered especially vulnerable at the eastern end of its range.

RECOMMENDATIONS:

Research: Taxonomic studies to validate and distinguish subspecies
Captive programs: Not at the present time. Need to develop protocols.
PVA: Not required
Other action: No specific recommendations.

SECURE.

TAXON: Anthracoceros coronatus convexus

Mace-Lande status: Safe
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Four species in genus; 4 sub-species
Distribution: Greater Sundas and Bali
Sub-populations: 30
Field studies: Pan, K.A.; Malaysian wildlife department
Captive status:: >30
CONCERNS/COMMENTS:

Not of immediate conservation concern; one of the most adaptive hornbills. A good model for captive husbandry.

RECOMMENDATIONS:

Research: Verify taxonomy
Captive programs: Nucleus; use as model for other species
PVA: No
Other action: No specific recommendations.

TAXON: Anthracoceros malayanus deminutus
Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Four species in genus; 2 sub-species
Distribution: Borneo and its islands
Sub-populations: One
Field studies: None known
Captive status:: > 16 for combined sub-species
CONCERNS/COMMENTS:

One of the most commonly seen species. Appears unusually adaptable to habitat change.

RECOMMENDATIONS:

Research: Taxonomy; population size and distribution
Captive programs: Not required at present; no recommendation
PVA: No
Other action: No specific recommendation.

TAXON: Anorrhinus galeritus

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Monotypic genus
Distribution: Greater Sundas
Sub-populations: 3
Field studies: None known
Captive status:: >10
CONCERNS/COMMENTS:

Adaptable, can be found in secondary growth. Dull colors probably make this species less desirable for trade.

RECOMMENDATIONS:

Research: Surveys of population size and distribution
Captive programs: Not needed; no recommendation
PVA: No
Other action: No specific recommendation.

TAXON: Rhyticeros cassidix cassidix

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Eight species in genus; 2 sub-species
Distribution: Sulawesi
Sub-populations: 4
Field studies: Renee Dekker (KULILOR)
Captive status:: <100
CONCERNS/COMMENTS:

Adopted by South Sulawesi as their provincial symbol.

RECOMMENDATIONS:

Research: Verify subspp.; survey population numbers and distribution
Captive programs: Nucleus
PVA: No
Other action: No specific recommendation.

TAXON: Penelopides exarhatus exarhatus

Mace-Lande status: Secure
CITES: Appendix II
IUCN Red Data Book: not listed
Local: All Indonesian hornbills protected under Animal Protection Ordinance 1931 and Act #5 of 1990 concerning conservation of living resources and their ecosystems. Capture trade and export are prohibited.
Taxonomic uniqueness: Two species in genus; 2 sub-species
Distribution: North Sulawesi
Sub-populations: 2
Field studies: Refer to Rene Dekker (KULILOR); Derek Holmes
Captive status:: < 10 for combined sub-species
CONCERNS/COMMENTS:

Virtually nothing known. Not thought to be of immediate concern but threatened by habitat loss.

RECOMMENDATIONS:

Research: Verify taxonomy; survey population size and distribution
Captive programs: Pending. Dependent on taxonomic findings; pending
PVA: Dependent on taxonomic findings
Other action: No specific recommendation

HORNBILL CONSERVATION ASSESSMENT AND MANAGEMENT PLAN

FIRST REVIEW DRAFT

Report from the workshop held
24-26 September 1991
Singapore

Edited by
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Compiled by the Workshop Participants

SECTION 8

AFRICAN TAXA

Table 15. HORNBILL TAXA (Africa)

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
3	TOCKUS	FASCIATUS	(2 SUBSPP)	SENEGAMBIA E.TO UGANDA, N.ANGOLA	>1,600,000	4	2	S	?	S	NONE	N		TAX	N	3	
4	TOCKUS	ALBOTERMINATUS	(4 SUBSPP)	S.ETHIOPIA, S.AFRICA, ANGOLAE TO MOZAMBIQUE & TANZANIA	>1,800,000	1	4	S	?	S	NONE	N		SRV, TAX	N	3	
5	TOCKUS	BRADFIELDI		N.NAMIBIA, S.ANGOLA, W.ZAMBIA, NWZIMBABWE,N. BOTSWANA	396,800	4	1	S?	?	S	NONE	N		--	N	3	
6	TOCKUS	PALLIDIROSTRIS	(2 SUBSPP)	S.ANGOLA E. TO S.TANZANIA &MOZAMBIQUE	1 MILLION	4	2	S	?	S	NONE	N		--	N	3	
7	TOCKUS	NASUTUS	(3 SUBSPP)	SAVANNAS OF SUBSAHARAN AFRICA	>3 MILLION	1	3	S	?	S	NONE	N		TAX	N	3	
8	TOCKUS	HEMPRICHII		ETHIOPIA, C.KENYA, N.SOMALIA&SUDAN	422,400	4	1	S?	?	S	NONE	N		--	N	3	
9	TOCKUS	MONTEIRI		S.ANGOLA & N.HALF NAMIBIA	78,000	1	1	S	?	S	NONE	N		--	N	3	
13	TOCKUS	HARTLAUBI	(2 SUBSPP)	LIBERIA E. TO W. UGANDA, S. TO ZAIRE	>1 MILLION	4	2	S?	?	S	L	N		--	N	3	

	TAXON			WILD POPULATION										CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	DQ	SUB PDP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
14	TOCKUS	CAMURUS	(2 SUBSPP)	LIBERIA E. TO W.UGANDA, S. TO ZAIRE	>700,000	4	2	S?	?	S	NDNE	N		--	N	3	
15	TOCKUS	ERYTHRORHYNCHUS	(3 SUBSPP)	SUBSAHARAN AFRICAN SAVANNAS	>500,000	1	3-5	S	?	S	NDNE	N		--	N	3	
16	TOCKUS	FLAVIROSTRIS	(3 SUBSPP)	ETHIOPIA S.TO N.TANZANIA, S.SUDAN & E. UGANDA	>600,000	4	2	S?	?	S	UNK	N		--	N	3	
17	TOCKUS	LEUCOMELAS		S. ANGOLA & MOZAMBIQUE S.TO S.AFRICA	408,000	1	2	S	?	S	NONE	N		SRV	N	3	
18	TOCKUS	DECKENI		S.ETHIOPIA, W.SOMALIA, KENYA, N.TANZANIA, E.UGANDA	323,000	4	2	S?	?	S	NONE	N		TAX	N	3	
20	TOCKUS (TROPICANUS)	ALBOCRISTATUS	ALBOCRISTATUS	SIERRA LEONE TO IVORY COAST	<10,000	4	2	D	B	S	L	N			N	3	
21	TOCKUS (TROPICANUS)	ALBOCRISTATUS	MACROURUS	GHANA, TOGO	<10,000	4	2	D	A	S	L	N			N	3	
22	TOCKUS (TROPICANUS)	ALBOCRISTATUS	CASSINI	W.NIGERIA TO GABON & UGANDA	>10,000	4	1	D	D	S	L	N			N	3	
73	CERATOGYMNA	ELATA		W. AFRICA - CAMEROON W. TO S. SENEGAL	>10,000	4	3	D	B	V	L,H	Y	Y	SRV	I	3	
74	CERATOGYMNA	ATRATA		LIBERA E. TO UGANDA AND S TO N.ANGOLA	>10,000	4	4	D	E	S	L,H	N	N	SRV	N	3	
76	CERATOGYMNA (BYCANISTES)	CYLINDRICUS	CYLINDRICUS	LIBERIA E. TO W. UGANDA	<10,000	4	3	D	E	S	L	N		SRV	N	3	

	TAXON			WILD POPULATION											CAPTIVE PROGRAM		
	SCIENTIFIC NAME			RANGE	EST#	OO	SUB POP	TRND	AREA	M/L STS	THRT	PVA	WILD MGMT	TAX/ SRV/ HUSB	CAP REC	DIFF	NUM
77	CERATOGYMNA (BYCANISTES)	CYLINDRICUS	ALBOTIBIALIS	CONGO FORESTS	>10,000	4	1	D	D	S	L	N		--	N	3	
78	CERATOGYMNA (BYCANISTES)	SUBCYLINDRICUS		CÔTE D'IVOIRE E. TO W.UGANDA S. TO N.ANGOLA	?	1	5	S	?	S	L	N		SRV	N	3	
79	CERATOGYMNA (BYCANISTES)	BREVIS		ETHIOPIA S. TO ZIMBABWE	?	4	?	S?	?	S	L	N		SRV	N	3	
80	CERATOGYMNA (BYCANISTES)	BUCINATOR		S. TANZANIA S. TO S. AFRICA, W. TO ANGOLA & ZAIRE	>10,000	4	1	D	E	S	L	N		SRV	N	3	
82	CERATOGYMNA (BYCANISTES)	FISTULATOR	FISTULATOR	W. GUINEA RAINFORESTS	<10,000	4	3	D	B	S	L	N		SRV	N	3	
83	CERATOGYMNA (BYCANISTES)	FISTULATOR	SHARPII	E. GUINEA RAINFORESTS	<10,000	4	2	D	B	S	L	N			N	3	
84	CERATOGYMNA (BYCANISTES)	FISTULATOR	DUBOISI	CONGO FORESTS	>10,000	4	1	D	E	S	L	N			N	3	
97	BUCORVUS	ABYSSINICUS		GAMBIA TO C. KENYA	?	?	1	S		S	L,H	N	Y	SRV	NUC	?	?
98	BUCORVUS	CAFER (LEADBEATERI)		S. KENYA AND BURUNDI TO S. AFRICA	?	1	1	S		S	L,H	N	Y	SRV	N	?	?

AFRICAN WORKING GROUP
Chairman: A. Kemp

VULNERABLE.

TAXON: Ceratogymna elata

Mace-Lande status: Vulnerable
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two species of wattled hornbill, previously in own genus *Ceratogymna*
Distribution: Forest of W Africa from Cameroon west to S Senegal
Subpopulations: Range fragmented, but exact details unknown
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) Possibly most threatened African hornbill, most restricted in range of all African forest species and distribution covers area of most intense forest destruction. Shows some tolerance of secondary forest conditions.
2) Subjected to heavy hunting and extirpated in some areas
RECOMMENDATION
Research: Census details and field biology studies
Captive programs:: Establish captive stock
PVA: Yes
Other actions: Establish status in larger national parks and locate countries where of symbolic importance for further protection

SECURE.

TAXON: Tockus fasciatus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of four species in subgenus Rhynchaceros within genus of 14 species.
Distribution: Lowland forests from Senegambia east to Uganda and south to N Angola
Subpopulations: Two distinct subspecies (*fasciatus, semifasciatus*)
Field studies: None in detail (Brosset and Erard 1986)
Captive studies: None
CONCERNS/COMMENTS:
1) The commonest and most widespread of all African lowland forest hornbills
RECOMMENDATIONS:
Research: Basic field study, examine exact subspecific/specific status
Captive programs:: None essential
PVA: No

TAXON: Tockus alboterminatus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of four species in subgenus Rhynchaceros within genus of 14 species
Distribution: Hill and coastal forests from S Ethiopia south to South Africa and from Angola and Cabinda east to Mozambique and Tanzania
Subpopulations: At least four forms recognizable (alboterminatus, geloensis, suahelicus, australis) but intergrade, although generally fragmented across total range due to relatively special habitat requirements.
Field studies: Well studied (Range 1949-52)
Captive studies: Bred in captivity but not well studied
CONCERNS/COMMENTS:
1) Common within somewhat localized range and tends to range widely during drier conditions
RECOMMENDATIONS:
Research: Assess extent of population differentiation and determine status of major populations
Captive programs:: None essential
PVA: No

TAXON: Tockus bradfieldi

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Protected in Namibia, Botswana and Zimbabwe, probably also in Zambia
Taxonomic uniqueness: One of four species in subgenus Rhynchaceros within genus of 14 species, very closely allied to *alboterminatus*
Distribution: Restricted range in N Namibia, S Angola, W Zambia, NW Zimbabwe, N Botswana
Subpopulations: None recognized but some isolates e.g. on Waterberg in Namibia
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) Vulnerable due to localized range but generally in remote areas, widely protected and occurs within several large reserves (Hwange, Chobe, Caprivi, Waterberg)
RECOMMENDATIONS:
Research: Basic biology
Captive programs:: None essential
PVA: No

TAXON: Tockus pallidirostris

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two species in subgenus Lophoceros within genus of 14 species
Distribution: Denser and taller woodlands of S Angola east to S Tanzania and Mozambique
Subpopulations: Two distinct subspecies (*pallidirostris, neumanni*) on either side of Luangwa Valley, Zambia
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) Favors taller Brachystegia woodlands and hence somewhat vulnerable to timber and firewood cutting (Malawi, parts of Zambia)
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Tockus nasutus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two species in subgenus Lophoceros within genus of 14 species
Distribution: Savannas of subSaharan Africa, the only African hornbill to extend onto the SW Arabian Peninsular
Subpopulations: Two main subspecies (*nasutus, epirhinus*), approximately on either side of the equator, and Angolan (*dorsalis*) birds also separable
Field studies: Well studied (Kemp 1976)
Captive studies: Bred regularly but not much studied
CONCERNS/COMMENTS:
1) Widespread and common in all forms of savanna and more open woodland, with mobility during drier periods and wider habitat tolerances than any other African species
RECOMMENDATIONS:
Research: Assess subspecific/specific status
Captive programs:: None essential
PVA: No

TAXON: Tockus hemprichii

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of four species in subgenus Rhynchaceros within a genus of 14 species; unusual in subgenus for different display with fanned tail.
Distribution: Highlands of Ethiopia, extending south to central Kenya (L. Baringo) and just entering Somalia and Sudan
Subpopulations: None recognized
Field studies: None in detail (Brown 1976, Urban et al. 1970)
Captive studies: None
CONCERNS/COMMENTS:
1) Widespread but generally not common within range, but preference for wooded ravines and other remote areas
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Tockus monteiri

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Protected in main range in Namibia
Taxonomic uniqueness: One of five species in subgenus Tockus within a genus of 14 species, occupies most arid habitat of any hornbill species
Distribution: S Angola and northern half of Namibia
Subpopulations: None recognized
Field studies: Well studied (Kemp & Kemp 1972, Riekert 1988)
Captive studies: None
CONCERNS/COMMENTS:
1) Widespread and common within restricted range
2) Will use nest boxes where tree or rock holes are limited
RECOMMENDATIONS:
Research: Seasonal movements and habitat requirements
Captive programs:: None essential
PVA: No

TAXON: Tockus hartlaubi
Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two diminutive forest species in a genus of 14 species.
Distribution: Lowland forest from Liberia east to W Uganda and south to Zaire
Subpopulations: Two distinct subspecies (*hartlaubi, grantii*)
Field studies: None in detail (Brosset & Erard 1986)
Captive studies: None
CONCERNS/COMMENTS:
1) A shy but widespread species, only found regularly in primary forest and so vulnerable to cutting and other destruction of habitat.
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Tockus camurus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two diminutive forest species in a genus of 14 species
Distribution: Lowland forest from Liberia east to W Uganda and south to Zaire
Subpopulations: West and central African forms can be distinguished (*camurus, pulchirostris*)
Field studies: None in detail (Brosset & Erard 1986)
Captive studies: None
CONCERNS/COMMENTS:
1) A widespread and conspicuous species, with noisy calls, unique within the genus for breeding in cooperative groups. Tolerant of secondary as well as primary forest
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Tockus erythrorhynchus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of five species in subgenus Tockus within genus of 14 species
Distribution: Subsaharan African savannas
Subpopulations: Three, maybe five, distinct populations, based on plumage, displays and soft part colors, several of which may deserve specific status.
Field studies: Well studied (Kemp 1976, Wambughu 1988)
Captive studies: Often bred in captivity
CONCERNS/COMMENTS:
1) Widespread and locally common species but exact status of some subpopulations unknown
RECOMMENDATIONS:
Research: Determine details of subspecific/specific differentiation.
Captive programs:: None essential
PVA: No

TAXON: Tockus flavirostris

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of five species in subgenus Tockus within genus of 14 species, was previously considered subspecies with *leucomelas*
Distribution: Arid savanna from Ethiopia south to N Tanzania and west to S Sudan and E Uganda
Subpopulations: Extreme western forms separable (*somaliensis*)
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) Little known relative to southern sister species
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Tockus leucomelas

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of five species in subgenus Tockus within genus of 14 species, was previously united with *flavirostris* as subspecies
Distribution: Savanna of southern Africa from S Angola and Mozambique south to South Africa
Subpopulations: Western populations distinctive (*elegans*)
Field studies: Well studied (Kemp 1976)
Captive studies: Bred widely in captivity
CONCERNS/COMMENTS:
1) Widespread, common and most catholic of small savanna hornbills in southern Africa
RECOMMENDATIONS:
Research: Examine subpopulation structure
Captive programs:: None essential
PVA: No

TAXON: Tockus deckeni

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of five species in subgenus Tockus within genus of 14 species
Distribution: S Ethiopia, W Somalia, Kenya, N Tanzania and E Uganda
Subpopulations: NW population (*jacksoni*) well differentiated and often recognized as separate species
Field studies: None
Captive studies: None but have bred repeatedly in captivity
CONCERNS/COMMENTS:
1) Common in drier savannas
RECOMMENDATIONS:
Research: Basic field biology and determination of subspecific/specific status
Captive programs:: None essential
PVA: No

TAXON: Tockus (Tropicranus) albocristatus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of 14 species in genus, but aberrant and was previously placed in monotypic genus *Tropicranus*
Distribution: Lowland forests from Liberia east to W Uganda and south to Zaire
Subpopulations: Three distinct subspecies (*albocristatus, macrourus, cassini*).
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) Widespread and common forest hornbill, well suited to include secondary growth in range.
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Ceratogymna atrata

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of two species of wattled hornbill, previously in own genus *Ceratogymna*
Distribution: African rain forests from Liberia east to Uganda and south to N Angola
Subpopulations: None recognized but some habitat fragmentation, especially in west Africa
Field studies: None in detail (Chapin 1939, Brosset and Erard 1986)
Captive studies: Few (Poulsen 1970)
CONCERNS/COMMENTS:
1) Some local habitat and hunting pressure. Still widespread and common in many areas.
2) Subjected to heavy hunting and extirpated in some areas
RECOMMENDATIONS:
Research: Details of field biology
Captive programs:: None essential
PVA: No
Other actions: Assess status in larger national parks

TAXON: Ceratogymna (Bycanistes) cylindricus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of seven species in genus, two distinct subspecies that possibly deserve specific status (*cylindricus* and *albotibialis*).
Distribution: Rain forests from Liberia east to W Uganda
Subpopulations: Two distinct subspecies, some local fragmentation
Field studies: None in detail (Chapin 1939, Brosset and Erard 1986)
Captive studies: None
CONCERNS/COMMENTS:
1) Generally uncommon and exact status uncertain
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: Not essential
PVA: No

TAXON: Ceratogymna (Bycanistes) subcylindricus

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of seven species in genus, two well differentiated subspecies
Distribution: Borders of African rain forest from Côte d'Ivoire east to W Uganda and south to N Angola
Subpopulations: Two clear subspecies and whole range highly fragmented into at least five separate areas
Field studies: Well studied (Kilham 1956, Kalina Ph.D., 1990)
Captive studies: Numbers in captivity and have bred (Bourne & Chessell 1982, Porritt & Riley 1976)
CONCERNS/COMMENTS:
1) Seems adapted to forest edge and well suited to accept some secondary forest development. However highly fragmented range places small subpopulations under long-term pressure.
RECOMMENDATIONS:
Research: Assess sizes of subpopulations
Captive programs:: No further work essential
PVA: No

TAXON: Ceratogymna (Bycanistes) brevis

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of seven species in genus
Distribution: Montane and coastal forests from Ethiopia south to Zimbabwe
Subpopulations: Fragmented throughout range due to specific habitat requirements but no subspecific differentiation
Field studies: Good early studies (Moreau and Moreau 1941 and references therein)
Captive studies: None
CONCERNS/COMMENTS:
1) Locally common but range restricted, fragmented and therefore vulnerable to local forest cutting and development
RECOMMENDATIONS:
Research: Assess status of local populations
Captive programs:: None essential
PVA: No
Other actions:

TAXON: Ceratogymna (Bycanistes) bucinator

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of seven species in genus, no subspecific differentiation
Distribution: Coastal and riverine forest from S Tanzania south to South Africa and west to Angola and Zaire
Subpopulations: No obvious separation of populations and wander widely
Field studies: None
Captive studies: None in detail (Stonor 1936)
CONCERNS/COMMENTS:
1) A widespread and locally common species showing no obvious declines but vulnerable to habitat degradation along rivers
RECOMMENDATIONS:
Research: Basic field biology
Captive programs:: None essential
PVA: No

TAXON: Ceratogymna (Bycanistes) fistulator

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country
Taxonomic uniqueness: One of seven species in genus, divided into three well differentiated subspecies
Distribution: Primary and secondary rain forest from S Senegal east to W Uganda and south to N Angola
Subpopulations: Three distinctive subspecies (*fistulator, duboisi, sharpii*).
Field studies: None
Captive studies: None
CONCERNS/COMMENTS:
1) A widespread and common species, the smallest in the genus and most tolerant of different forest conditions. However subject to some local fragmentation and populations of west African forests (fistulator) most vulnerable
RECOMMENDATIONS:
Research: Status of nominate form in west Africa
Captive programs:: None essential
PVA: No

TAXON: Bucorvus abyssinicus

Mace-Lande status: Secure
CITES: not listed
IUCN Red Data Book: not listed
Local: Differs with country
Taxonomic uniqueness: One of ditypic genus (and family? Sibley & Monroe 1990)
Distribution: African subSaharan savanna south to Uganda and Kenya.
Subpopulations: Apparently contiguous
Field studies: Unnecessary
Captive studies: Number in captivity and studied (Penny 1975)
CONCERNS/COMMENTS:
1) Some local habitat fragmentation and human density pressures
2) Head and neck used as hunting decoy in some areas (Cameroon, Hausaland).
RECOMMENDATIONS:
Research: Basic wild biology and population study
Captive programs:: Well established, not essential
PVA: No
Other actions: Check conservation status in larger national parks

TAXON: Bucorvus cafer (leadbeateri)

Mace-Lande status: Secure
CITES: Not listed
IUCN Red Data Book: Not listed
Local: Differs with country, e.g. protected South Africa, Zimbabwe, Namibia, Botswana.
Taxonomic uniqueness: One of ditypic genus (and family? Sibley & Monroe 1990)
Distribution: African savannas south of the equator, from S Kenya and Burundi south to South Africa
Subpopulations: Apparently contiguous
Field studies: Well studied in South Africa (Kemp 1988 and references therein)
Captive studies: Numbers in captivity but few detailed studies

CONCERNS/COMMENTS:

1) Local extirpation and habitat loss (70% loss in South Africa), some loss in Zimbabwe.
2) Some hunting for medicinal purposes and trade but generally revered.

RECOMMENDATIONS:

Research: Continue basic biology studies
Captive programs:: Explore harvesting of second chicks, captive breeding and reintroduction
PVA: Unnecessary, to be performed locally for Kruger National Park
Other actions: Establish conservation status in larger national parks

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Compiled by the Workshop Participants

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SECTION 10

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SECTION 11

REFERENCE MATERIAL

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.*

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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).

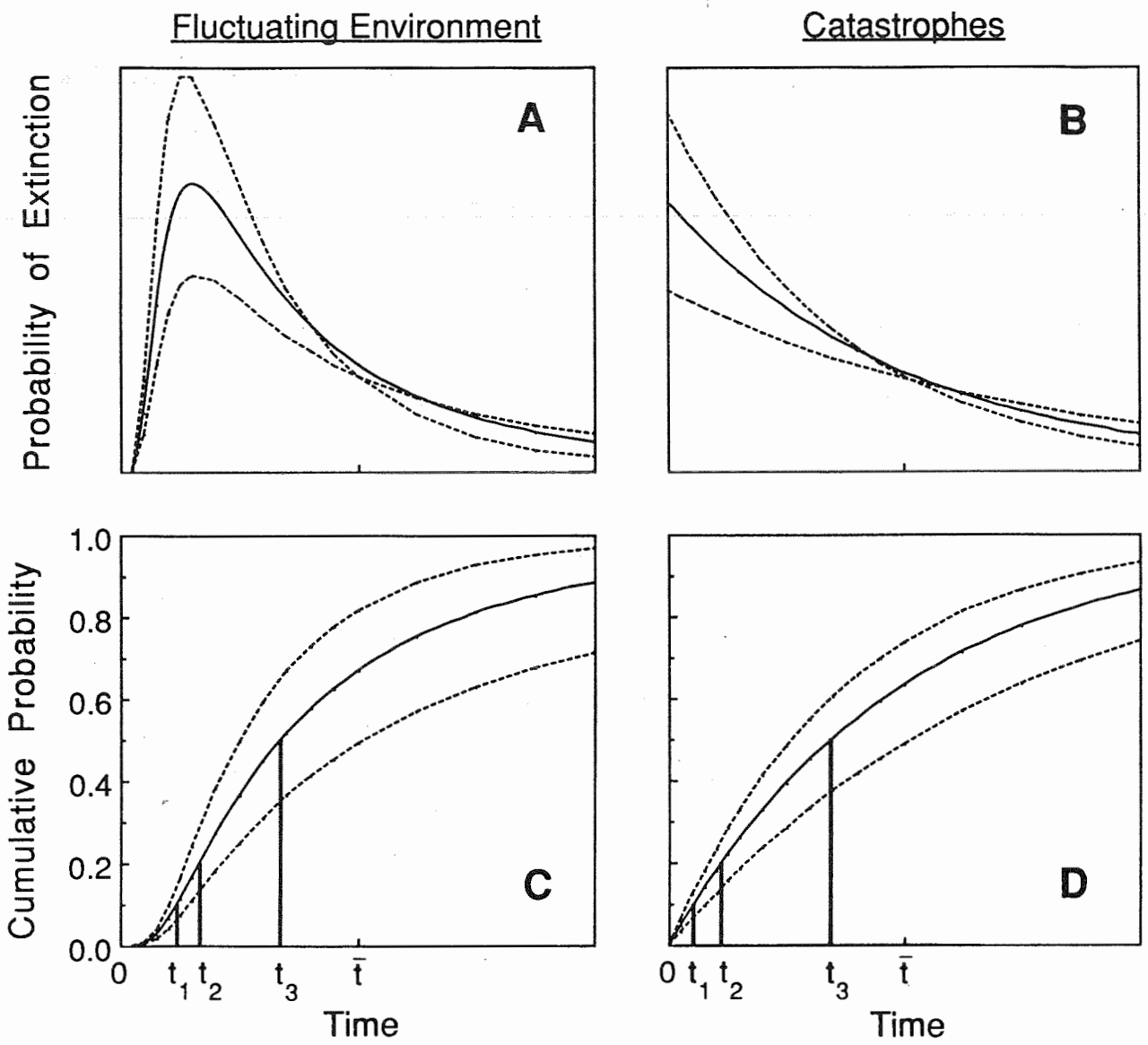

Figure 1. Probability distributions of time to extinction in a fluctuating environment, inverse Gaussian distributions (A), or with catastrophes, exponential distributions (B). Corresponding cumulative extinction probabilities of extinction up to any given time are shown below (C and D). Solid curves 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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