ASIAN WILD CATTLE CONSERVATION ASSESSMENT AND MANAGEMENT PLAN WORKSHOP

Chonburi, Thailand
21 - 25 July 1995

WORKING DOCUMENT

EDITED BY
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HOSTED BY
Khao Kheow Open Zoo

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The Zoological Parks Organization of Thailand
The Royal Forest Department of Thailand
IUCN/SSC Asian Wild Cattle Specialist Group
IUCN/SSC Conservation Breeding Specialist Group

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WORKING DOCUMENT

October 1995

Report from the workshop held
21-25 July 1995
Chonburi, Thailand

SECTION 1

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Executive Summary

The goals of the Asian Wild Cattle CAMP workshop were:

1. To review the population status and demographic trends for Asian Bovini, to assign New IUCN Red List (IUCN, 1994) categories of threat and to identify management options for Asian Wild Cattle taxa.

2. To provide recommendations for *in situ* and *ex situ* management, research and information-gathering for all Asian Wild Cattle taxa, including: recommendations for PHVA workshops; more intensive management in the wild; taxonomic research, survey, monitoring, investigation of limiting factors, taxonomy or other specific research.

3. To produce a draft Conservation Assessment and Management Plan for Asian Wild Cattle, presenting the recommendations from the workshop for review by workshop participants and distribution to all parties interested in Asian Wild Cattle conservation.

The CAMP Workshop was organized by the Conservation Breeding and Asian Wild Cattle Specialist Groups in collaboration with the Thailand Royal Forestry Department and the Zoological Parks Organization. The Workshop was conducted at the Khao Kheow Open Zoo in Chonburi, Thailand, 21-25 July 1995. About 43 experts from 16 countries on wild and captive management of the Asian Wild Cattle for an intensive and interactive review of their status in each range country. Participants in the Thailand Workshop formed 4 working groups (Gaur and Yak; Banteng and Kouprey; Anoa and Tamaraw; Buffalo) to: 1) determine best estimates of the status of all Asian wild cattle taxa; 2) assign each taxon to a IUCN Category of Threat; and 3) identify areas of action and information needed for conservation and management purposes. Much of this information was available in the draft Action Plan by Simon Hedges (1995) which was used extensively as a reference. Participants in the Workshop and the composition of the working groups are listed in the Appendix.

The assessments and recommendations of the working groups were circulated to the entire group twice prior to production of the final workshop draft as represented in this document. Summary recommendations concerning research, management, assignment of taxa to appropriate threat status and captive breeding goals were supported by the workshop participants. Special topic working groups convened to discuss and prepare reports on issues of importance to Wild Cattle in Southeast Asia. The topics considered were taxonomy, disease, assisted reproduction and survey, census and monitoring techniques. The reports from these working groups were circulated in draft form and agreed upon by all workshop participants. The special topic reports are in Section 2.

Results

Twenty-five distinct Asian Wild Cattle taxa (species, subspecies and/or populations) were considered by the Asian Wild Cattle Conservation Assessment and Management Plan Workshop. Of these, 22 taxa were assigned to one of the following categories, based on the New IUCN Red List criteria (see Appendix for category definitions and explanations):

Table 1. Threatened Asian Wild Cattle Taxa - New IUCN Categories of Threat.

NEW IUCN CATEGORY OF THREAT	NUMBER OF TAXA	PERCENT OF TOTAL
Extinct	0	0
Extinct in Wild	0	0
Critically Endangered	7	32
Endangered	6	27
Vulnerable	3	14
Lower Risk (Conservation Dependent)	0	0
Lower Risk	1	4.5
Data Deficient	4	18
Not Evaluated	1	4.5
TOTAL	22	100

The specific criteria by which these assignments were made are listed on the taxon data sheets.

The three additional taxa (*Bos javanicus, Bos gaurus, Bubalus bubalis*), considered as undifferentiated taxa (ie. as species rather than subspecies or geographically defined populations) were not assessed. They are assessed in the IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan, however, and in that document the following New IUCN Red List (IUCN, 1994) categories have been assigned based on the noted criteria: *Bos javanicus*: Endangered (A1c,d; A2c,d; C1; C2a); *Bos gaurus*: Vulnerable (A1c,d; A2c,d; C1; C2a); *Bubalus bubalis*: Endangered (A2e; C1).

Table 2. List of Asian Wild Cattle taxa according to IUCN (1994) categories.

Category & List #	TAXON	COUNTRY
Critically Endangered		
2	*Bubalus bubalis*	Thailand
3	*Bubalus bubalis*	Nepal
4	*Bubalus bubalis*	Central India
16	*Bos gaurus laosiensis*	Myanmar to China
17	*Bos gaurus hubbacki*	Thailand, Malaysia
22	*Bos javanicus birmanicus*	Myanmar to Vietnam
25	*Bos sauveli*	Cambodia, Lao PDR, Vietnam
Endangered		
5	*Bubalus bubalis*	India (Assam), Bhutan
11	*Bubalus depressicornis*	Indonesia (Sulawesi)
13	*Bubalus mindorensis*	Philippines (Mindoro)
21	*Bos javanicus javanicus*	Indonesia (Java)
23	*Bos javanicus lowi*	Borneo (ie. Indonesia, Malaysia)
Vulnerable		
12	*Bubalus quarlesi*	Indonesia (Sulawesi)
18	*Bos gaurus frontalis*	Myanmar, South China
24	*Bos muticus*	China, India
Lower Risk		
15	*Bos gaurus gaurus*	India, Nepal
Data Deficient		
6	*Bubalus bubalis*	Cambodia?
7	*Bubalus bubalis*	Vietnam?
8	*Bubalus bubalis*	Borneo
9	*Bubalus bubalis*	Sri Lanka
10	*Bubalus bubalis*	Laos? (Ex?)
Not Evaluated		
19	*Bos gaurus (forma) frontalis*	India

Table 3. Regional distribution of threatened Asian Wild Cattle taxa.

Country	Taxa & IUCN Category of Threat						Total
	CR	EN	VU	CD	LR	DD	
Borneo	0	1	0	0	0	1	2
Cambodia	3	0	0	0	0	1	4
China	1	0	2	0	0	0	3
India	1	1	1	0	1	0	4
Indonesia	0	2	1	0	0	0	3
Laos	3	0	0	0	0	1	4
Malaysia	1	0	0	0	0	0	1
Myanmar	2	0	1	0	0	0	3
Nepal	1	0	0	0	1	0	2
Philippines	0	1	0	0	0	0	1
Sri Lanka	0	1	0	0	0	0	1
Thailand	5	0	0	0	0	0	5
Vietnam	3	0	0	0	0	1	4

Recommendations

1. Six of the 22 taxa (27%) were recommended for Population and Habitat Viability Assessment (PHVA) workshops. PHVA recommendations are pending for 4 additional taxa.

2. 77 recommendations for Research Management were made in the following categories:

Survey	19 taxa
Monitoring	19 taxa
Life history research	3 taxa
Habitat management	10 taxa
Taxonomic research	19 taxa
Limiting factors research	3 taxa
Other	4 taxa

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

Table 4. Research management recommendations for Asian Wild Cattle.

Topic	Recommendations by IUCN Category			Total
	CR	EN	VU	
Survey	7	5	3	15
PHVA	3	2	1	6
PHVA Pending	1	1	2	4
Monitoring	6	5	3	14
Life History	0	2	1	3
Habitat Management	3	4	3	10
Taxonomy	5	5	3	13
Husbandry	2	0	1	3
Limit Factors Research	0	2	1	3

3. Fourteen of the 25 taxa are present in captivity (56%). Seven of the 25 Asian Wild Cattle taxa (28%) were recommended for one of three levels of captive programs (based in part on IUCN Red List criteria):

Table 5. Captive program recommendations for Asian Wild Cattle by threat category.

IUCN Category	Level 1	Level 2	Level 3	Pending	No
Critical	2	1	0	2	2
Endangered	2	0	0	1	3
Vulnerable	2	0	1	1	0
TOTAL	6	1	1	4	5

Captive programs for 3 taxa were listed as "pending," meaning that recommendations for such would be postponed until further information was available, either from survey, a PHVA, or other sources. Eleven species/subspecies/populations were identified as not requiring captive programs.

4. Captive Breeding of Gaur: During the Asian Wild Cattle CAMP Workshop the issue of subspecies hybridization of the captive population of gaur, *Bos gaurus*, was discussed. A consensus conclusion was that breeding of these populations does not represent conservation of this species. The following recommendation resulted from this discussion:

   All captive gaur populations managed for conservation purposes should immediately stop breeding subspecies hybrids.

5. Investigate extent of hybridization between Banteng and domestic/feral cattle in Java.

6. Quantify the differences (in genetic and external, as well as skull and horn characters) between the Assam, Central Indian/Nepal and Thailand buffaloes, and assess the status of the Vietnam, Cambodian, Lao, and Bornean buffaloes.

7. Determine if there are subspecies in *Bos mutus*, *Bubalus depressicornis*, and *Bubalus quarlesi*. Determine if *Bubalus depressicornis* and *Bubalus quarlesi* are subspecies of the same species. Determine the relationship of the Malayan Gaur (*Bos gaurus hubbacki*), to the Southeast Asian Gaur (*Bos gaurus laosiensis* and *Bos frontalis laosiensis*)?

8. Move the wild populations of *Bubalus bubalis* to CITES Appendix I (from III).

9. Develop a training program for survey, census, and monitoring techniques for field workers from each of the countries. Conduct the first sessions within the next 12 months.

10. Develop a quantitative model which incorporates information on extent and quality of habitat, indicator species affecting bovid abundance, and intensity of hunting pressures.

11. Collect samples for disease testing from all animals handled for research or field studies.

12. Establish a network of teams of wildlife, agriculture, and zoo veterinarians and diagnostic specialists to investigate disease outbreaks in wild cattle.

13. Establish a Genome Resource Bank for semen and embryos of wild cattle taxa.

14. Add Banteng *Bos javanicus* to CITES Appendix I.

15. Determine the relationship of banteng subspecies.

Table 6. Summary Data for All Asian Wild Cattle Taxa

	TAXON		WILD POPULATION													CAPTIVE PROGRAM		
	SCIENTIFIC NAME		Range	Ext Occ	Area Occ	# Loc	% Decl	Yr/ Gen	Pop #	DQ	Tent IUCN	Criter used	Threat	PHVA	Rsrch Mgmt Recs	Rec	Diff	Num
1	Bubalus																	
2	Bubalus	bubalis	Thailand	2575 km2	1200 km2	1	S	7?	<100	3	CR	C2b,D	Hyb,D, L,H	N	T,S,M	P	1	0
3	Bubalus	bubalis	Nepal	170 km2	100 km2	1	I-3%	7?	~110	2	CR	C2b	I,D, Hyb,L	N	S,M,T	N	1	9.18
4	Bubalus	bubalis	Central India	>20,000 km2	1900 km2	3	D-80%	7	~50	2	CR	A1a,D A1c,C2a	D,L,Hf, I,Hyb	PEND	S,M,T	N	1	43. 97.1
5	Bubalus	bubalis	Assam/ Bhutan	>20,000 km2	1800 km2	>6	D-20%	7	2800	2	EN	C1,A2c	Hyb,D,L, H,I	N	S,M,T	N	1	0
6	Bubalus	bubalis	Cambodia	>20,000 km2	4,000 km2?	4	?	7	?	4	DD/ CR?	C2	H,L,D,I Lf,Hyb	N	S,M, T,D	N	1	0
7	Bubalus	bubalis	Vietnam	?	<100 km2	2?	great D	7	?	4	DD/ CR?	C2	H,L,D,I Lf,Hyb	N	S,M,T	N	1	27.2 3
8	Bubalus	bubalis	Borneo	?	?	?	?	7?	?	4	DD		H,I,D,L Lf,Hyb	N	S,M,T	N	1	4.10
9	Bubalus	bubalis	Sri Lanka	>20,000 km2	>2,000 km2	6	?	7	3,000-3,500	3	EN	C2a	Hyb,D L,I	N	S,M,T	N	1	9.18
10	Bubalus	bubalis	Laos	?	?	?	D?	7?	?	4	DD/ CR?/ EX?		H,L,W,D, I,Lf,Hyb	N	S,M,T	N	1	0
11	Bubalus	depressicornis	lowlands of Sulawesi	~140,000 km2	<100,000 km2	>10	D?	6-8	?	5	EN	A1,C1, C2a	Hf,Ht,I, Lf,L	Y	T,Hm M,Lr Lh,S	1	1	27.2 3

	TAXON		WILD POPULATION													CAPTIVE PROGRAM		
	SCIENTIFIC NAME		Range	Ext Occ	Area Occ	# Loc	% Decl	Yr/ Gen	Pop #	DQ	Tent IUCN	Criter used	Threat	PHVA	Rsrch Mgmt Recs	Rec	Diff	Num
12	Bubalus	quarlesi	highlands of Sulawesi	<200,000 km2	<200 ,000 km2	>5	D?	6-8	<2,5 00	5	VU/EN	A1,C1, C2a	Hf,Ht,I,L f,L,T	P	T,Hm M,Lr, Lh,S	1	1	4.2
13	Bubalus	mindorensis	Mindoro Island in Philippines	<5,000 km2	<2,0 00 km2	4	S	6-8	300- 400	1	EN	B1,B2c, D1,C	Hf,Ht,I, Lf,L,D	Y	M,Hm, Lr,Lh	1	1	4.2
14	Bos	gaurus																
15	Bos	gaurus gaurus	Nepal, India, Bhutan, Bangladesh	>700, 000 km2	177,0 00 km2	>10 2	I	~8	36,00 0- 50,00 0	2/3	LR		D,Hf,L,Lf	N	T,M	N	1	0.3
16	Bos	gaurus laosiensis [readei]	1.Myanmar 2.Laos, 3. Cambodia 4.Vietnam, 5.Thailend, 6.China	>20,000 km2	>2,0 00 km2	~43	D	~8	6800- 8400	1	CR/EN	B,A1c,d, A2c,d	Hf,Ht, Hm,L, Lf,I	Y	T,M, S,Hm	1	2	?
17	Bos	gaurus hubbacki	Southern Thailand, Malaysia	>25,000 km2	100 km2	3	D-40%/ 15y	~8	400	1	CR	C2a	Hf,I,L, Ht	Y	T,S, M,H, Hm	1	1	22
18	Bos	gaurus frontalis	Myanmar, South China	260,000 km2	> 2,001 km2	3 Myan mar/ 1 Chin a	D?	~8	3500	3	VU	C2a,C1	Hf,Lf	P	T,S, M,Hm	3	2	~10 0
19	Bos	gaurus frontalis	India- domestic species	60,000 km2	?	?	I	8	>85, 000?	3	NE		?	N	T	N	2	Man y
20	Bos	javanicus																

	TAXON		WILD POPULATION												CAPTIVE PROGRAM		
	SCIENTIFIC NAME		Range	Ext Occ	Area Occ	# Loc	% Decl	Yr/ Gen	Pop #	DQ	Tent IUCN	Criter used	Threat	PHVA	Rsrch Mgmt Recs	Rec	Diff	Num
21	Bos	javanicus javanicus	Java, Bali?	~40,200 km2	~180 0-3000	~12	D?	~6 yr?	1,000-2,000	1,2,3	EN	C2a	L,D, H,Tp, Hyb	N	M,Hm, T,S,O	N	1	0
22	Bos	javanicus birmanicus	Myanmar, Cambodia, Vietnam, Laos, Thailand	>20,000 km2	>2,000 km2?	>23	D	~6 yr	2870-5770	1,2,3	CR	A1c,d, A2c,d	Ht,L,T, D,I,N, Lf,Tp	Y/P	S,M, H,Hm,O	2/P	2,3	>29
23	Bos	javanicus lowi	Borneo	>20,000 km2	>2,000 km2	>8?	D	~6 yr?	<1,500	3	EN	C1,C2a	Lf,L,I, Ht,Hyb	P	S,Hm,T	P	2	0
24	Bos	mutus (wild)	5 provinces of China; 2 of India	>20,000 km2	277,000 km2	6	D	~8	16,000-20,000	1	VU	A1d,A2dC	Lf,I, Hf,S	Y	T,S, M,H, Hm	1	3	2.2
25	Bos	sauveli	N Cambodia, Thailand, Laos, Vietnam	>20,000 km2	13,242 km2	≥2	D	?	<100	2,3,4	CR	A2d,C1, C2,D	G,Ht, Tp,Lf,W	N	S,O	P	3	0

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SECTION 2

SPECIAL TOPIC REPORTS

Taxonomy and Nomenclature

Introduction:
Normally, wild representatives of a species differ from domestic in -

- they are larger
- their horns turn more inward at the tips
  they have larger brain

The best criteria in any location are from comparison of the suspected wild individuals with known domestic individuals. Gene flow may be from wild to domestic, as well as from domestic to wild, so examine and characterize domestic stock at some distance from the wild population rather than on the periphery. The problem of stock movements must be taken into account. A large sample size is also required to ensure representativeness in the data set. Ideally a complete genetic screening (survey) would compare the wild and domestic types.

Definitions:
Taxonomy: classifying organisms
Nomenclature: what you call them once they are classified.

Terminology used to classify Asian buffalo

Wild buffalo.	Buffalo which have never been domesticated and which are not descended from domestic, feral or hybrid buffalo. (Wild buffalo can have mated with non-wild buffalo of course but they cannot be *descended* from non-wild buffalo.)
Wild type buffalo.	Free-living (i.e. neither domestic nor semi-feral) buffalo (contributing to the gene pool through hybridization but not part of a managed population) which are phenotypically distinct from local domestic buffalo and which show traits that are believed to be typical of the original wild buffalo of Asia (i.e. they resemble true wild buffalo in size, body conformation, horn length/shape, color and behavior); however, because their history is unknown the possibility that they are in fact feral or hybrid animals cannot be excluded.
Feral buffalo.	Buffalo are considered to be feral if they or their ancestors were formerly domestic but they are now living independently of humans.
Semi-feral buffalo.	Domestic buffalo which are allowed to roam freely for most of the time but which are recaptured on occasion.

Domestic buffalo.	Buffalo which are kept and bred by humans for any or all of the following purposes: the production of milk and/or meat, as working animals or for religious/cultural reasons. They are not allowed to roam freely for long periods and breeding is (mainly) controlled by their owners. As a consequence domestic buffalo are genetically different from wild buffalo.
Hybrid buffalo.	Is used to refer to the offspring of matings between any of the above (e.g. wild x domestic, wild x feral, wild type x domestic, etc.); could also be used to refer the offspring between valid subspecies of buffalo; and in theory for the offspring of interspecific unions, for example *Bubalus bubalis* x *B. mindorensis* crossbreeds (although none are known to exist).
Swamp buffalo.	A type of domestic buffalo particularly common in SE Asia (see Domestication section in main text).
River buffalo.	Another type of domestic buffalo (see Domestication section in main text).

The following buffalo populations are known to be wholly, mainly, or at least originally of wild stock: NE India (Assam)/Bhutan, Nepal, Central India, Thailand, Vietnam, Laos, Cambodia.

The following may or may not have an original wild basis: Sri Lanka, Borneo, South Sumatra (Lampung), Java.

Questions on hybridization:

1) Are there any genuinely feral Mithan (Gayal), or are they all owned - even those found free-ranging in the forest? Is gene-flow always one way (Gaur to Mithan) or can Mithan genes enter Gaur populations?

2) Borneo Banteng (*Bos javanicus lowi*) may be a genuine wild subspecies (they do differ from Java and mainland Banteng), or they may be of part-domestic (Bali cattle), or wholly domestic (Bali cattle and/or Humped cattle) origin. If genuinely wild, they should be homogenous. Comparisons between different Borneo populations should be made.

3) Investigate extent of hybridization between Banteng and domestic/feral cattle in Java.

Use of the comparative sample

Museum specimens are mostly from the Age of Big-Game Hunting (i.e. pre-World War II). Hybridization is presumably less of a problem in these old samples; indeed they are homogenous as would be expected in an unmixed wild population.

Skull measurements are always much less variable than horn measurements or horn shape. Variation in horn shape is not necessarily an indicator of hybridization.

Samples should be as large as possible, but statistical probability theory can be used to make significant statements based even on relatively small samples.

Naming wild and domestic animals

The rule about names is:

> Use the earliest available name (see the list of names distributed by Colin Groves, at the beginning of the CAMP). So, for the Southeast Asian Gaur, the earliest available name is *Bos gaurus laosiensis* - not *Bos gaurus readei*

Domestic forms are not Species and Subspecies in the same sense as wild ones. Because of this, some zoologists insist that the name given to a domestic animal should ***not*** be used for the wild representative (even if it is the earliest name!; see number 1 on table below). Others take the opposite view (see number 2 in table), and use the same name for both. Examples of alternatives that show this problem among the bovines are:

	1	2
Indian Gaur	*Bos gaurus gaurus*	*Bos frontalis gaurus*
Southeast Asian Gaur	*Bos gaurus laosiensis*	*Bos frontalis laosiensis*
Mithan	*Bos frontalis* (or, no scientific name)	*Bos frontalis frontalis*
Wild Yak	*Bos mutus*	*Bos grunniens mutus*
Domestic Yak	*Bos grunniens* (or, no scientific name)	*Bos grunniens grunniens*
Central Indian Wild Buffalo	*Bubalus arnee arnee*	*Bubalus bubalis arnee*
Assam Wild Buffalo	*Bubalus arnee fulvus*	*Bubalus bubalis fulvus*
Domestic Buffalo	*Bubalus bubalis* (or, no scientific name)	*Bubalus bubalis bubalis*

Both these name systems are in use. ***BE AWARE OF THEM!***

Residual taxonomic research necessary

1. Are there subspecies of wild yak? More skulls and other material, like photos and gene sequences, are needed from Kuen Lun, Ching Hai and the upper Yangtze.

2. Is the Malayan Gaur a separate subspecies (*Bos gaurus hubbacki*), or is it the same as the Southeast Asian Gaur (*Bos gaurus laosiensis* or *Bos frontalis laosiensis*)? Skulls, genetic data, etc. are needed.

3. Are there subspecies in *Bubalus depressicornis*? Are there subspecies in *Bubalus quarlesi*? Remember that subspecies are **geographic** variants within a species! Are *Bubalus depressicornis* and *B. quarlesi* themselves specifically distinct?

4. Quantify the differences (in genetic and external, as well as skull and horn characters) between the Assam, Central Indian/Nepal and Thailand buffaloes, and assess the status of the Vietnam, Cambodian, Lao, and Bornean buffaloes.

5. Assess the relationships of *Pseudoryx nghetinhensis* and *Pseudonovibos spiralis* and their applicability to the SSC/ Asian Wild Cattle vs Antelope Specialist Groups.

6. Assess the relationships of the Kouprey: is it related more closely to the Banteng, or to Aurochs and so to domestic cattle?

7. Determine the relationship of banteng subspecies.

Contributors: Bruce Read, Colin Groves, Simon Hedges, Joel Heinen, Mariano Gimenez Dixon

Asian Wild Buffalo Overview

Bubalus bubalis

A number of issues raised during the course of this process were of such importance that the working group felt they should be mentioned in the opening remarks. These issues deal with changes and concerns at the root level and many of them had a profound effect on how the data are presented. The decision by the working group was to treat the taxa in this group by populations instead of the traditional species/subspecies method. This approach is sensitive to the range countries as it recognizes the concerns and problems at a local or regional level. The group felt this strategy allows for making solid conservation recommendations that are more likely to be implemented due to their narrower focus.

Taxonomic Issues:

The issue of taxonomy for the *Bubalus* species was discussed at length. The opinion was put forward that *Bubalus arnee* be used to designate the wild populations and *Bubalus bubalis* be used to designate the domestic population. A contrary opinion maintained that all buffalo regardless of whether they are domestic or wild should be labeled as *Bubalus bubalis*.

The arguments for designating wild buffalo as *Bubalus arnee* were set forth as follows:

1. Taxonomic formality at a subspecies level and the different nature of the domestic and wild gene pools.
2. The need to conserve the wild gene pool.
3. The role of domestics is different from the wild.
4. The designation of different specific names held greater conservation value.

The arguments for designating all Asian buffalo as *Bubalus bubalis* were set forth as follows:

1. There are now innumerable feral and free-ranging domestic buffalo living within the range of (apparently) wild buffalo and in many cases interbreeding with them; consequently it is by no means clear which animals should be classified as belonging to the domestic"species".
2. The domestic "species" and the wild "species" are fully interfertile.
3. Feral populations of buffalo derived from domestic stock which were in turn descended from wild buffalo populations, races or subspecies which are now extinct (e.g. in Sri Lanka or Indonesia) may contain genetic material not found in wild buffalo populations and consequently there are good reasons for conserving them. Treating them as members of another "species" is to unnecessarily stigmatize them and runs the risk that their value will be overlooked.
4. Scientific names given to domestic animals are valid according to the Code of Zoological Nomenclature provided they conform to the other requirements of the Code (which *Bubalus bubalis* does).
5. The use of *Bubalus bubalis* has the additional advantages that it has conventionally

been used to refer to wild Asian buffalo by IUCN and is used by Honacki *et al.* (1982) which is the standard reference to mammalian nomenclature used by the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Following lengthy in-depth discussion the working group was unable to reach unanimous consensus. A motion was put forth to accept majority consensus with a written minority opinion to be submitted for inclusion in the Camp Document. There was a majority decision by the group to accept this motion and *Bubalus bubalis* was chosen for the specific designation. It was also stressed that a strong statement be included that the domestic population would be treated as a separate component. Dr. Colin Groves was petitioned to draft the minority opinion.

CITES Classification:

It is thought that there are only four remaining populations containing wild individuals of this species. They are the Thailand, Nepal, Central India and Northeast India/Bhutan populations. Based on current IUCN criteria, three of the four are critical, the other one is endangered. Hunting affects two of the three critical populations as well the endangered one. Recent evidence suggests that some trophies from these populations are being sold in border markets in the region. The justification for moving the species from its current listing of Appendix III (Nepal) to Appendix I (All populations) is that the species as a whole is in danger of extinction, hunting is a known threat to three of the four breeding populations and trade is thought to affect at least some of these. In the case of trophy hunting the largest adults are selectively removed and any removal of such animals further hastens the decline.

Education:

The issue of education was a recurring theme during the review of the taxon sheets. The group members felt that educational programs aimed at public awareness would greatly facilitate the protection of fragmented populations.

General:

Other topics that the group felt needed further attention included:

1. The problem of domestic hybrids.
2. The possibility of disease transmission.
3. Further taxonomic and genetic studies.
4. Need to develop acceptable criteria for differentiating wild and feral stock in areas with both.

Census, Survey and Monitoring Techniques

The Asian Wild Cattle Specialist Group has to deal with eight species in many different areas throughout south and southeast Asia. At the present time we know very little about how many animals actually remain and many of the counts which have been conducted have been brief and rather crude. Counts using robust and reliable techniques which can be carried out relatively quickly in the field are urgently needed.

Before starting an animal count the goals of the project must be well defined (i.e. what is the information needed for?). A major consideration is whether absolute numbers are ever required. In almost all cases indices of relative abundance combined with information on population trend is adequate for wildlife managers and conservation planners. Careful thought must be given to the level of confidence required, and the time, resources and number of interested and dedicated people available.

For the purpose of this report we will use the following definitions:

SURVEY: Attempt to produce an index of relative abundance.

CENSUS: Attempt to estimate the absolute number of animals in an area.

MONITORING: Attempt to assess population trends over time through repeated surveys or censuses.

Below is a list of potential techniques which can be used for censusing, surveying and monitoring wild bovid populations.

FAECAL TECHNIQUES

Advantages: relatively cheap (time and money required are low); good for estimating relative abundance. Better than sightings for low density populations. Major problems: confusion will arise if >1 species produce similar faeces, needs good quality data on decay rate, cannot be used for censuses unless information is available on defecation rate (very limited data are usually available), provides no information on population structure, and many animals defecate in a non-random fashion thus requiring a large sample size. Rainy season rapid decay rates in the tropics frequently make this technique unsuitable except in areas of high population density. There are two major ways of recording faecal abundance: line transects and plots.

1) Line transects. This includes any technique in which a known line is patrolled, and the distance from the line to the faecal piles are recorded. Advantages: can provide good quality data with confidence limits, a widely used technique; it is frequently more efficient than plot-based techniques, as more time is spent collecting data; allows for quantitative compensation for samples of unknown origin (i.e. dung from unknown species can be ignored during

surveys).

2) Plot-based techniques. This involves any technique in which plots are designated on the ground, and dung piles are counted within them. Advantages: in areas of very high abundance sampling is easier, more effective in areas of poor visibility such as tall grass, easier in rough terrain.

SIGHTING TECHNIQUES

Advantages: can also provide information on population structure and animal condition, usually no problem identifying species. Disadvantages: requires good visibility.

1) Line transects: Advantages include the fact that this method can provide good quality data with confidence limits, and that it is a widely-used and hence well-known technique. Difficult to do in areas of rough terrain or poor visibility; can't be used effectively along roads, rivers, or cut transects [for statistical reasons], therefore, walking a known line and recording distances is difficult; for herding animals, results are expressed in density of groups (possibly reducing the utility of the data); can be very time consuming, especially in areas of low density.

2) Drive counts: This technique involves having many people walking systematically through a known area and counting animals that are flushed. Requires many people, a good organizer, good visibility and large animals. Even in the best conducted drive counts, some animals will be missed leading to under estimation of density.

3) Count/recount known animals: This technique is based on the same idea as capture/mark/recapture. Requires individual identification of a sufficient number of animals in the population, and good visibility such that resightings are frequent.

4) Concentration counts: Any simultaneous count made at points where animals may congregate, such as water holes, mineral licks, etc. This method can only be used for crude monitoring within an area.

5) Automatic camera "traps": Any set up involving the use of cameras with automatic trigger systems (e.g. trip wires), such that an animal may be photographed as it moves through the area. This method may be justified for very rare species in which sufficient funding is available. Most useful for determining presence/absence. Possibly allows for the identification of individuals.

6) Aerial surveys: Very expensive, appropriate in areas that are large and at least seasonally open.

7) Block searches: Predefined blocks are systematically searched ideally using teams of people. All animals sighted are recorded. Advantages: Produces detailed information on

habitat, behavior and ecology in addition to numbers. Disadvantages: Requires much organization, preparation, large numbers of people, time, and money.

TRACK COUNTS

For large, herding animals, the technique is only of any use for determining presence/absence of a species in an area, provided there are no other similar species or domestic forms in the area.

DISCUSSION

The issue of which technique/s to use for various purposes is complex, and depends on factors such as available resources (financial, time, and manpower), environmental conditions, size of the area to be surveyed, number of similar species in the area, and behavior of the animal in question. In general we recommend the following techniques for the different purposes of surveying, censusing, and monitoring.

Recommended Methods:

Census	Surveying	Monitoring
Faecal Techniques*	Faecal techniques	Faecal techniques
Sighting transects	Sighting transects	Sighting transects
	Drive counts	Drive counts
Count/recount known animals		
		(Concentration counts)
Aerial surveys	Aerial surveys	Aerial surveys
Block searches	Block searches	

*Faecal techniques only used if no other options are available because of problems inherent in determining decay and defecation rates.

If the goal of the project is simply to determine the presence or absence of a species in an area then concentration counts, automatic camera "traps" and track counts may be used. Of these track counts would be the cheapest but a common problem with the wild cattle and buffaloes is that we often have more than one species (or wild, feral and domestic members of the same species) with similar footprints within the same area.

We recommend that prior to the start of any census or survey advice is sought from people with experience of counting large terrestrial herbivores in similar environments, and from statisticians with knowledge of biological surveying.

Development of a modelling approach.

Quantitative models for estimating relative population size and potential trends for large mammals can be developed. Such models can be useful but previous attempts have focused on available remaining habitat and have not considered other factors limiting animal numbers, in particular hunting which has been identified as a major threat to wild bovids throughout most of Asia.

We recommend that a model be developed which incorporates information about extent and quality of available habitat, presence or absence of indicator species which may positively or negatively affect large bovid abundance; and the intensity and nature of hunting pressures. These variables are then combined with the results of brief surveys in the area to produce an estimate of likely abundance and expected future trends. The intention is that such a model would produce categories of relative abundance (very low, low, medium, high) and predicted trends (e.g. stable, increasing, decreasing).

Clearly such a model would require validation. By validation we mean that several areas are selected and for each area data on habitat parameters are collected, hunting pressure is assessed and high quality censuses are conducted. The model which best predicts actual abundance from the available habitat and hunting data can then be assessed for utility, applicability and repeatability. If it is judged to be adequate it can then be used to produce rapid estimates of abundance in other areas.

A valuable start has been made for Asian wild cattle. Dr Sompoad Srikosamatara and his colleagues have begun to develop and use a model to estimate gaur and banteng abundance in protected areas in Thailand. The results suggest that estimating hunting pressure is both difficult and crucial. Further research on this topic is urgently needed to validate and refine the model. Such an approach is both timely and relevant considering how many areas have wild cattle and buffalo populations, the multiple threats to these populations, and the need to identify significant populations of all species of Asian wild bovids before they disappear.

Contributors: Simon Hedges, Joel Heinen, Martin Tyson, Sompoad Srikosamatara

Disease Communication

Diseases of domestic livestock and wildlife can have devastating effects on populations of wild cattle and may significantly contribute to species extinction. The concern with wildlife disease is only intermittently addressed. This working group compiled a preliminary list of diseases present in the region that can pose some degree of threat to the wild populations. These diseases were then classified according to whether or not they posed a severe threat to populations or posed only moderate or no threat to populations. All of the diseases listed below are known to occur in domestic livestock in the region, although the incidence within each country varies widely. For many of these diseases there are documented cases in wildlife species.

I. Diseases posing a severe threat to wild cattle populations if there is an outbreak. These diseases are considered highly transmissible between individuals or may effect large numbers of animals in a region and have high mortality.

Rinderpest 1) 150 buffalos died in 1981 at Kaziranga NP in India. A. Choudhury, pers comm, 1994.
2) gaur, large die off in 1963 in Orisa State. A. Choudhury, pers comm.
3) 1967 - gaur in western Assam. A. Choudhury, pers. comm.
4) 1968 - gaur Bandipur.
5) 1972 - gaur Orissa.
6) 1974 - gaur Periyar.
7) 1976 - gaur Kanha.

Foot and Mouth Disease

1990, gaur in Chiang Mai (K. Sanvang, pers. comm.)

Serum titer of 1:80 for Foot and Mouth disease (FMD) type O confirmed in one free-ranging gaur immobilized and sampled in Chitwan Park, Nepal in March 1992. Same animal was resampled in April, 1993 after radio collar tracking. FMD - O titer in 1993 was 1:40. Two other animals sampled from the same herd were negative for FMD. All 3 animals in the group were positive for Blue tongue. Serologic tests were all performed as Plum Island, USDA-FAD Diagnostic Laboratory.

Tuberculosis
Trichomoniasis

Hemorrhagic Septicemia (Pasteurella multocida): 1990 - 2 gaur at the Melacca Zoo, Malaysia. Malaysia. Vet. Proceedings, 1993.

Anthrax: 1993-1994 - A few Rhino and elephant in North Bengal, India (A. Choudhury, pers. comm.)

II. Diseases posing a moderate threat to wild cattle populations. These diseases are considered to be less transmissible, to produce less mortality or primarily produce abortions or other

problems which can effect populations:

Jembrana (Rickettsial disease in Banteng)

Bubiarsa, I.T. and Hardjosworo, S. (1976). Jembrana disease in Bali cattle. Australian Vet. Journal 52 (2):97.

National Research Council (1983). Little Known Asian Animals with a Promising Economic Future. National Academy Press, Washington D.C., USA.

Sweatman, G.K. (1994) Potential Arachnid Vectors - Jembrana disease: an epidemiological study. In: W.B. (ed) Mammalian Diseases and Arachnitis. Vol. 1 Pathogen Biology and Clinical Management, CRC Press Inc., Boca Raton, FL.

Brucellosis

Bovine Paratuberculosis (Johne's disease)

1978 - Camels in Singapore Zoo (K. Pillai pers. comm.)

Chronic Toxic Hepatitis 1993 - 3 (2.1) tamaraw in captivity. (In: Phil. J. Vet. Med. 30(2): 75-78).

Blackleg (Clostridium chauvoeii)

Anaplasmosis

Babesiosis

Leptospirosis

1993 - Tamaraw in captivity. (In: Phil. J. Vet. Med. 30(2): 63-64.

Bovine virus diarrhea

Infectious bovine rhinotracheitis

Bovine spongiform encephalopathy

Piroplasmosis

Malignant catarrhal fever

1984 - gayal in KKOZ (S. Kamolnv, pers comm.)

Parasites

Melioidosis

1978 - Sika deer in Zoo Negara, Malaysia. Journal of Vet Medicine 1979.

Rabies

Sarcosporidiosis

1992 - One gaur at Dusit Zoo (W. Wichasil, pers. comm.)

Liver fluke infestation

1985 banteng male at Chiang Mai Zoo (K. Sanwong, pers. comm.)

Escherichia coli in neonates

1992 - Young banteng at Chiang Mai Zoo (K. Sanwong, pers. comm.)

Parasites of tamaraw in captivity at the Gene Pool Farm (Philippines, 1993).

Trematodes

Calicophoron calicophoron
Fasciola sp.

Nematodes

Oesophagostomun radiatum
Mecistocirrus digitatus
Haemonchus sp. and *Trichuris* sp.

Cestode

Moniezia sp.

Ixodid ticks

Amblyomma sp.
Boophilus microplus
Rhipicephalus sanguineus

Louse *Haematopinus tuberculatus*

III. Diseases posing little or no threat to populations but highly significant to individual animals.

Bluetongue

1991 - 21 Cervus timorensis at University Pertanian, Malaysia (J. Vet Med. Fatina et al., 1992)

Foot rot

1995 - Wild banteng at Huai Khao Khaeg Wildlife Sanctuary (T. Prayurasiddhi, pers. comm.)

Intra and interspecies aggression injuries

Hunting injuries

Recommendations

The disease concerns working group formulated the following recommendations concerning disease in wild cattle:

1) Complete necropsies need to be performed and disease testing samples collected in every case in which an animal is found dead.

2) Each country needs to establish team on network of wildlife veterinarians, Livestock Development or agriculture veterinarians, zoo veterinarians and diagnostic specialists (such as virologists) to investigate animal deaths.

3) A system needs to be established in each country to insure that all disease outbreaks in domestic livestock be immediately reported from the Livestock Development or Agriculture Department to the Wildlife Department of that country.

4) Livestock Development or Agriculture Departments in each country need to

immediately communicate information about disease outbreaks in their country to neighboring or bordering countries.

5) Wild cattle populations should be regularly monitored for disease symptoms. Visual observation should be the minimum goal. Organized systems of disease testing sample collection from wild cattle populations is desirable.

6) All wildlife field studies that involve animal immobilization need to include the collection of sample to test for disease in the wildlife population found in the area.

7) Field studies should be initiated to study the movement of animals (home range, migration) in border regions in particular with regard to the possibility of disease transmission and prediction of disease transmission outbreak movement.

8) Animals to be translocated between populations or areas must be captured, examined and tested for disease entities that may pose a threat to other wildlife at the translocation site prior to the movement to the new site.

Contributors: Zainuddin Awang Lela, Ma Yiqing, Kumar Pillai, Khin Than Win, Su Su Oung, Wichit Kongkharn, Youngchai Autara, Visit Vichansil, Visit Arsaithamkul, Chatri Khoohathapharak, Razeem Mazlan A. and Ruben Callo.

Assisted Reproductive Technologies

Introduction

Genome banking offers the opportunity to expand the scope, time span, scale, security, and economy of programs for conservation of species and of within species genetic diversity. As populations of wild cattle species are fragmented in distribution and reduced in numbers, genetic diversity is lost and the populations become increasingly vulnerable to extinction. Some of the species are vulnerable to hybridization with domestic cattle or domesticated stock of wild species. Cryopreservation of representative samples of genomic materials from wild and captive populations will allow indefinite preservation of presently available diversity and protection against extinction. Additionally, cryobanking will assist in the genetic management of living wild and captive populations.

Formulation of goals and objectives for a genome banking program are necessary for development of sampling and utilization strategies to guide : (1) selection of an optimal representation of the genetic diversity, (2) collection and storage of an adequate amount of material, and (3) distribution and use of the appropriate materials. These materials may then be used to assist restoration of extinct wild populations, genetically supplement small living wild populations, assist in the exchange of genetic material between previously connected wild populations, and support smaller captive populations with indefinite retention of presently available genetic diversity.

The utilization of genome banks as part of an integrated program of management of living wild and captive populations may allow retention of a larger fraction of the present genetic diversity in the wild populations with smaller living captive populations. It also may be possible to distribute semen/embryos to other sites without removing animals from threatened populations. These might then be inseminated/transferred to surrogate hosts to produce living populations as a basis for further expansion of the genome bank, introductions to other sites, or supplementation of wild population. The living population could receive periodic infusions from the genome bank to replace diversity lost by drift or to maintain a closer correspondence to the genetic composition of the wild population. The cryopreserved materials will allow indefinite (thousands of years) retention of the present day genetic diversity which will significantly modify current goals for captive conservation programs based upon 90% retention of genetic diversity for 100 or 200 years in the captive populations.

This capability to retain more diversity with smaller living captive populations should allow a dramatic (4-10 fold) expansion of the number of species or evolutionary significant units that might be supported with living captive populations and genome banks. This expansion in the number of species to be managed will greatly increase our need for systemic data collection, analysis, and distribution and for simpler development of species management plans. The addition of another mode for protection of species against loss should further secure them from extinction from catastrophic events and the impacts of continuing loss of habitat quantity and quality.

Semen/embryo Collection and Cryopreservation

Developing a bank for cryopreserved wild bovid semen/embryos will:

A. reduce the number of animals needed to ensure high levels of genetic diversity;
B. combined with artificial insemination and embryo transfer, offer opportunities for improving captive breeding;
C. facilitate the infusion of germ plasm from wild populations into captive breeding programs without removing more animals from the wild;
D. eliminate animal transport risks;
E. provide insurance against the loss of diversity from epidemics, natural disasters and social/political upheavals;
F. be potentially useful for reducing disease transmission;
G. be useful as research/ "model" potentially benefiting other conservation biology programs

1. The success of cryopreservation depends on the appropriate collection, freezing and thawing of relatively large numbers of potentially fertile spermatozoa from genetically important males and recovery of genetically desirable embryos. The ultimate measure of the success of cryopreservation is the ability to use thawed sperm/embryos to generate live, healthy offspring.

2. There should be (a) less emphasis on the idea that a genetic resource bank is only a static "warehouse" and (b) more emphasis that such banks should be continually upgraded and used dynamically and interactively to support and enhance living populations.

3. There should be (a) less emphasis on the idea that a genetic resource bank is created simply by the collection and freeze-storage of germ plasm and (b) more emphasis that a genetic resource bank is only as valuable as the post-thaw viablility of stored materials and the ability of this material to generate live offspring.

4. It is mandatory that the banking of wild bovid semen/embryos be properly and accurately inventoried.

5. There are 2 primary reasons for collecting and freezing wild bovid spermatozoa/embryos:
   A. research to improve and embryos culture cryopreservation efficiency and the overall utility of the genetic resource bank.
   B. inclusion in a formal resource bank to be stored indefinitely or used to enhance captive breeding and sustain genetic diversity.
6. In most cases, it is more efficient, cost-effective and sufficiently safe to collect wild cattle semen by electroejaculation than to train a bull to an artificial vagina. Adequate anesthesia and electroejaculation protocols are in place to safely collect

good or high quality semen for most wild bovid species.

7. To collect embryos it is imperative that an appropriately designed barn is utilized and that the animals are properly conditioned. A clean, aseptic laboratory area is recommended for embryo handling and processing.

8. Assuming that post-thaw sperm viability is acceptable (see below) and these sperm can be proven to be biologically functional in vitro or in vivo, then a pre-banking research program is non-essential.

9. In cases where initial freezing trials indicate that more research involving wild bovid semen / embryo cryopreservation is necessary, then high priority studies will include:

A. comparative in vitro studies to examine the impact of various factors on post-thaw viability including:

	SEMEN	EMBRYO
i. cryoprotectant	concentration	type
ii. cryoadditive	surfactants, sugars	sucrose, proteins
iii. microbiological factors	antibiotics	washing steps
iv. morphology	% abnormal	quality grade
v. freezing approach	liquid nitrogen vapor	slow cooling, vitrification
	dry ice	
vi. pre-freeze processing	seminal plasma removal	washing
vii. physiological variable	pH, osmolality	osmolality
viii.cryoprotectant dilution	rate	steps

B. assessing the utility of functional tests (e.g., zona penetration assays).

C. in vivo studies with domestic cattle of conspecifics artificially inseminated with thawed spermatozoa.

1. We recommend two approaches for testing the viability of thawed sperm. First, it is highly appropriate to conduct preimplantation embryo studies whereby advanced hybrid or conspecific embryos are flushed from the uterus of domestic cattle or conspecific recipients (over-represented "surplus" females), respectively, on Days 5 to 8 post-artificial insemination. We also recommend that studies be conducted which, in part, rely on the production of term pregnancies and hybrid offspring. This not only will test the biological competence of thawed sperm but also will produce offspring useful as recipients for future embryo transfer efforts.

D. for wild (non-cattle) bovids in which conspecific recipients may be mandatory, it will be necessary to explore the: overall structure of the reproductive tract

(some species have bifurcated cervices of other unique features); ability to time anesthesia on ovulation or sperm transport; the efficiency of site of insemination (vaginal versus intracervical versus intrauterine) ; the utility of alternative insemination approaches (laparoscopy or ultrasound).

E. determining the minimum number of normal motile sperm that will accomplish in acceptable results. It will be useful to determine the minimal post-thaw sperm viability and dose of wild cattle semen inseminated into domestic cattle recipients. However, a higher priority is to establish the minimum sperm dose and quality for wild (non-cattle) bovids because domestic cattle criteria may not be acceptable for these species.

10. We recommend that the minimal acceptable criteria for fresh semen to be used for AI be as follows:
    F. 70% normal progressive sperm motility and
    G. 70% normal structural morphology (based on the evaluation of at least 200 sperm)

    However, we also recommend that all collected semen samples from genetically important males be banked, at least initially. We realize that, with present technology, this germ plasm may be minimally useful for artificial breeding, but could be used in future in vitro fertilization systems (i.e. IVF, sperm injection)

11. Any semen freezing technique can be used for a given bovid species as long as the resulting post-thawed sperm meet all the following minimal in vitro criteria:
    H. 20 million progressively normal motile sperm/insemination dose.
    I. at 0 hours, these sperm must have a motility rating of at least 25%, a moderate progressive status rating and at least 50% intact acrosomes.
    J. at 3 hours, these sperm must have a motility rating of at least 15%, a moderate progressive status rating and at least 30% intact acrosomes.
12. It is recommended further, if the majority of thawed ejaculates meets these minimal post-thaw criteria, that this semen freezing procedure remain consistent for this species. Likewise, if embryo viability is acceptable then this procedure should be appropriately standardized.
13. Thawed seminal aliquots falling below these minimal criteria should not be used for artificial insemination. During the testing trails with embryos, all specimens should be cultured or transferred. If cultured, at the conclusion of the analysis each specimen should be re-preserved for further examination (i.e. pathogen interaction studies, refer to Schiewe et al., 1995, Theriogenology, Vol. 63:62-70)
    The semen freezing techniques that presently can be recommended as general guideline to initiate the freezing of wild bovid sperm are as follows:
    K. for wild cattle, the suggested extenders are Modified Tris or Triladyl (Barth and Bowman, Can. Vet. J., 1986; Asa et al. and Gross et al., 1991 WC Symposium).
    L. for wild bovids, in general, these same extenders should be used as well as

BF5F and EQ. (for more details see Howard et al.; J. Reprod. Fert. 78:295-306, 1986; Schiewe et al,. J. Zoo Wildlf. Med. 22:58-72, 1991)

M. upon collection of semen, antibiotics and extenders should be added immediately.

N. extended semen should be cooled at approximately 0.3 degrees/minute from ambient temperature to 5°C. For other than Triladyl, the final glycerol concentration of the extended semen should be 7%.

O. extended semen should be equilibrated and maintained with glycerol at 5°C for 2 to 4 hours before freezing. Semen should be contained in sealed straws (0.25 or 0.5 ml) and frozen using either a liquid nitrogen vapor (static- or forcedair) or dry ice method.

P. Semen should be thawed using a 35°C water bath for 30 seconds, immediately prior to use.

14. The personnel to conduct the semen/embryo collection and freezing should be chosen on the following basis:

Q. if on-site expertise is available, these individuals should be responsible for the actual processing and banking of the specimens; or

R. if on-site expertise is unavailable, consultation or supervision should be obtained from the appropriate scientific collborator(s).

15. Regardless of the personnel freezing the germ plasm, it is essential that a quality control program be put in place, whereby sperm frozen locally is assessed by one additional independent laboratory to ensure the samples meet minimal criteria. Since samples are to be maintained at 2 sites, we recommend the personnel at the "second" site be responsible for checking the quality of semen to be included in the bank.

**issues of cryobanking strategies emphasizing importation, system management and storage considerations have been previously detailed (Armstrong et al., 1991; Schiewe et al., 1995) and should be used as reference material.

Armstrong DL and TS Gross (eds.) 1991. In: Wild Cattle Symposium Proceedings. Omaha's Henry Doorly Zoo. Omaha, NE, USA.

Schiewe et al., 1995. Embryo importation and cryobanking strategies for laboratory animals and wildlife species. Theriogenology 63:62-70.

CAPTIVE WILD CATTLE IMMOBILIZATION PROTOCOL

Safety

This protocol is based on approximately 180 captive gaur immobilization procedures performed at the Henry Doorly Zoo in Omaha, Nebraska U.S.A. since 1987 and 6 free ranging gaur immobilization procedures performed in Chitwan National Park, Nepal in 1992 and 1993 as well as recommendations from veterinarians experienced in banteng immobilization. In the course of these procedures only one unexplained death of a normal, healthy gaur has occurred, a captive gaur at the Henry Doorly Zoo in 1988.

There can be a great deal of variation in the drug dose required to immobilize animals. This variation occurs as a result of differences in animal temperament, sensitivity to drugs and excitability. Drug doses required are also effected by the space available for the animal to run after drug injection, amount of animal stimulation that occurs just prior to drug injection and other factors. Captive gaur in Omaha are effectively immobilized with lower doses of xylazine and carfentanil than was required to safely immobilize free ranging animals in Nepal. Captive banteng in North American zoos require lower carfentanil doses for immobilization than do captive gaur. The drug dose that will be required to immobilize an animal in a particular situation cannot be precisely predicted. Consequently a drug dose range is proposed for each immobilizing drug.

In the interests of animal safety, drug doses used for initial immobilizations in a new set of circumstances, such as Thai Zoos, should be conservative in nature. Initial doses will be from the lower end of the range for each immobilizing drug. If animals are inadequately immobilized then supplemental drug doses may be administered. Higher drug doses may then be used on subsequent animals. Previous experience indicates that this approach will provide a reasonably safe approach to dosing animals for immobilization.

Preanesthetic Considerations

Enclosure - Immobilization of wild cattle can be accomplished in a wide range of enclosures. However, some characteristics of the enclosure are necessary for animal and personnel safety. It is essential that the enclosure: 1) restrict the animals movement to a small area but leave enough room for the animal to lay down in lateral recumbency, 2) have walls that are high enough and strong enough to confine an aggressive animal but also permit access to the animal for pole syringing or capture dart administration through gaps between bars or openings, 3) provide many solid places to which ropes can be tied from the animals legs in order to prevent kicking during procedures, 4) have gates for personnel that can be opened and closed quickly to permit rapid access to the animal if necessary, and 5) have a level, dry, well bedded floor. As an example, the enclosure at the Henry Doorly

Zoo which is most suitable for gaur immobilizations is 8 meters long by 4 meters wide. Walls are 2.2 meters in height and three of the pen walls are constructed of 11 cm welded hollow iron pipe placed vertically with 30 cm gaps between the pipes. Support posts for these walls are set in concrete. The floor is level, grooved, well drained concrete which is heavily bedded with straw during immobilizations to prevent animal injury. The pen may be entered through four different gates all of which can be opened or closed and locked quickly if necessary. The welded pipe construction of the walls permits complete visibility of the animal at all times, provides numerous points of access to the animal for injections via the gaps between the pipes and allows leg ropes to be tied to pipes at virtually any point on the walls.

Food - Animals should receive no food for 48 hours before the immobilization in order to prevent bloating and regurgitation during procedures.

Water - Animals should have access to water removed for 12 hours prior to immobilization.

Medical History - Each animals medical record should be reviewed before its immobilization to identify any previous immobilization difficulties and any pre-existing medical problems which should be examined or treated during the procedure.

Animal Identification - Records concerning the animals date and place of birth, sire and dam or date and site of capture should be reviewed prior to immobilization.

Personnel - A sufficient number of people must be available to move animals once they're down. This will probably require 6 people.

Immobilization

Xylazine - 0.05-0.25 mg/Kg intramuscularly.
Xylazine is an α-2 adrenergic tranquilizer administered with the immobilizing drug carfentanil. Xylazine helps quiet the animal and reduces the amount of immobilizing drug required.

Carfentanil(Gaur) - 0.01-0.03 mg/Kg intramuscularly.
Carfentanil is a semi synthetic immobilizing drug related to Etorphine (M99 or Immobilon) but more potent. Carfentanil immobilizes the animal to permit procedures to be performed.

Carfentanil(Banteng) - 0.001-0.003 mg/Kg intramuscularly.
Captive banteng in North American zoos are immobilized with the same drugs as gaur. However, they appear to be more sensitive to carfentanil than gaur are. Consequently, a lower initial dose range for carfentanil use in banteng is recommended. The xylazine dose range would remain the same. The carfentanil dose may be increased if immobilization is not effective at this lower range.

Intramuscular injections of xylazine and carfentanil will be performed by either pole syringe or capture dart depending upon access to the animal. Over a 5-10 minute period the animal will become progressively sedated and ataxic until it lays down in sternal recumbency. The animal may roll into lateral recumbency. If the animal is not in sternal recumbency after 20 minutes following the initial injection then a supplement of carfentanil will be administered intramuscularly to complete the immobilization. The dose of any supplements will depend upon the behavior of the animal and effect of the previous dose.

Ketamine - 0.5-1.0 mg/Kg intravenously.
Ketamine is a disassociative anesthetic used as a supplement during immobilization procedures to deepen the level of anesthesia. Ketamine may be administered intravenously at any time during the procedure when the animal kicks or swings his head in response to stimulation or is otherwise determined to be insufficiently immobilized.

Pre Examination Procedures

Respiratory Rate - The respiratory rate will be continuously monitored throughout the procedure.

Positioning - The animal will be positioned in lateral recumbency with all four legs extending out from the animal. The animal will be positioned so that if it kicks it will not hit a post, wall or other solid object that will injure it. The head and neck of the animal will be extended to ensure that the airway is open. The head and horns will be positioned with the nostrils next to the ground so that in the unlikely event that regurgitation occurs, the fluid will run out of the mouth rather than into the trachea. The veterinarian will check the nostrils to confirm that they are not obstructed by bedding, dirt or other material.

One person will be assigned to a position at the animals head to watch the animal for unusual movement and to monitor respiration.

Restraint - Individual pads will be placed around the metatarsal areas on each rear leg. Separate ropes will then be tied around each rear leg over the pads and then tied to a secure post behind the animal. These ropes prevent unexpected kicks from injuring people working around the animal. The front legs will be tied together and secured by a rope to a post in front of the animal.

Examination Procedure

Heart Rate - 44-72 beats/minute. Heart rate will be auscultate with a stethoscope.

Respiratory Rate - 6-24 breaths/minute. Lung sounds will be auscultated by stethoscope.

Temperature - 99°-101°F. Body temperature will be checked rectally.

Rectal Palpation - Palpation of bulbo-urethral gland and other structures.

Additional Procedures - Visual examination of eyes, ears, mouth, teeth and hooves. Palpation of prescapular lymph nodes and testicles. Measurement of testicle length and width.

Procedures

Identification - the following permanent identification markers will be placed.

1. A numbered, plastic cattle ear tag will be placed in the animal's right ear.
2. A numerical tatoo will be placed in the left ear. (The identification number will be determined by the zoo or Wildlife Department.)
3. A numbered metal clip tag will be placed in the left ear.
4. A Trovan identification transponder will be placed subcutaneously at the base of the left ear.

Sample Collection -

Blood - a 100ml blood sample will be drawn from the jugular vein. The whole blood sample will be divided as follows:

5ml - EDTA or other anticoagulant for complete blood cell counts of red and white blood cells.

10ml - whole blood for Bluetongue Virus isolation.

85ml - placed in serum tubes. This should yield 40-50ml of serum. 10ml of this serum would be used for serum chemistry analyses to assess the health of the animal. 10-20ml of serum will be used for infectious disease testing purposes. 10-20ml of serum will be placed in frozen storage for later testing if needed and as a back up sample in case other samples are lost.

Oesophageal - pharyngeal scraping - a scraping of the wall of the oesophagus will be collected by way of a metal cup inserted through the mouth and into the upper esophagus. This sample is for virus isolation procedures and will consist primarily of mucous and will be stored frozen in liquid nitrogen.

Skin biopsy - a site on the shoulder of the animal will be clipped and surgically scrubbed with betadine and alcohol. A 6mm punch biopsy of the full thickness of the skin will be collected for genetic analysis. This sample will be stored frozen in liquid nitrogen. The biopsy site will be sutured with 2-0 PDS suture. Multiple samples could be collected.

Semen collection - semen will be collected by electroejaculation. Prior to beginning the stimulation procedure the penis will be externalized by gentle traction with a cable loop. The penis will be maintained in a position external to the penile sheath by a hand-held loop of cotton gauze placed around it. A 5cm diameter, three electrode electroejaculation probe will be inserted in the animals rectum. A series of mild electrical stimulations will be applied through this probe to cause ejaculation into a water jacketed artificial vagina placed over the tip of the penis. The stimulations will consist of 3 series of 18 stimulations each. The first stimulation in each series will be at 2 volts and each subsequent stimulation will increase in 0.5 volt increments to 10 volts which ends the series. Each stimulation will last 2-3 seconds. Some movement of the rear legs will occur during each stimulation.

Semen will be collected in a warmed, water jacketed artificial vagina. **Following completion of the collection a 0.5ml sample of raw, unextended semen will be stored frozen in liquid nitrogen for disease testing.** The remaining semen will be evaluated, processed and frozen in 0.5ml artificial insemination straws for storage in liquid nitrogen.

Evaluation and Processing

Immediately following semen collection, total ejaculate volume will be determined and a 0.5ml sample of raw semen will be set aside for disease testing. Antibiotics are then added [2% final concentration from stock solution of: polymyxin B (61 mg/l), dihydrostreptomycin (1 g/l), penicillin-G (500,000 units/l)] in accordance with NAAB (National Association of Animal Breeders, Columbia, MO) recommendations for venereal pathogen control. Antibiotic treated semen will then be incubated at 37°C and evaluated for pre-freeze viability.

Initial evaluations include analyses of % motility, sperm concentration, morphology and progressive status. Morphology will be determined from examination of >100 cells prepared with Therio Stain and classification of sperm as normal or abnormal, including abnormal head (macrocephalic, microcephalic, degenerate); abnormal midpiece (bent residual, cytoplasmic droplet); abnormal flagellum (bent, coiled). Sperm concentrations will be estimated by dilution (1:100) into a blood-diluting pipette (BD-WBC-Unopette, Becton-Dickinson Co., Rutherford, NJ) and counting with a Neubauer hemacytometer. Progressive status is based on a rating scale of 0-5 (0 = no movement, 1 = little movement, 2 = movement and poor forward progression, 3 = slow forward progression, 4 = steady forward progression and 5 = rapid forward progression).

Following these initial evaluations, semen will be diluted 1:0.5 with non-glycerated cryodiluent/extender and cooled to 5°C over a 1.5 h incubation period prior to addition of the remaining non-glycerated extender and an additional incubation at 5°C for 0.5h. Extension volumes are determined by adjustment for the % motility and % normal morphology to obtain a concentration of 120 x 10^6 viable sperm/ml following the non-glycerated extension (first extension). The equation utilized to determine the volume following the first extension and the volume of glycerated extender to be added is as follows:

Total Volume Following First Extension and Volume of Glycerated Extender =

$$\frac{\text{(Semen Volume; ml) (conc.; x } 10^6\text{) (Motility) (Morphology)}}{120 \times 10^6}$$

The final glycerated extension (7% glycerol final concentration) is added in 3 steps at 20 min intervals (25% of the volume during the first step, 25% during the second step and 50% during the third step) to obtain a final concentration of 60 x 10^6 viable sperm/ml. Extended semen will then be subjected to a final equilibration for 1 h at 5°C prior to loading into 0.5ml straws and freezing.

Only semen samples of $\geq$ 40% motility, $\geq$ 2.0 progressive status and $\geq$ 150 x 10^6 sperm/ml will be utilized for cryopreservation procedures. A standard field cryopreservation procedure will be employed using a liquid nitrogen (LN_2) vapor freezing procedure.

Liquid nitrogen vapor freezing involves an equilibration of straws in liquid nitrogen vapors (-159°C) for 10 min prior to placing in liquid nitrogen storage.

Post-thaw Evaluations

Semen will be evaluated at 5-7 days after freezing and placement into liquid nitrogen storage. Semen will be thawed (n = 2 to 8 samples per bull) in a 37°C water bath for 30 sec and evaluated immediately (0 h) and following incubation for 2 h at room temperature (2 h). Post-thaw evaluations include analyses of % motility, morphology and progressive status.

Treatments

The following treatments will be administered to each animal during the immobilization procedure.

Benzathine penicillin - 30,000 units/Kg administered subcutaneously. This is a long-acting antibiotic given prophylactically to help prevent minor secondary infections at dart injection sites, biopsy sites and tatoo sites. Alternative antibiotics may be used, if they are more suitable to the circumstances.

Vitamin E/Selenium - administered subcutaneously. This vitamin and mineral injection is administered prophylactically to help prevent muscle soreness or capture myopathy.

Ivermectin - 0.2mg/Kg administered subcutaneously. This is an anthelminthic which reduces the animals parasite load.

Other treatments or vaccinations may be administered as deemed necessary by veterinarians in charge of the animals care.

Reversal

Following completion of the above procedures, all restraining ropes will be removed from the legs. The immobilizing drug will then be reversed with naltrexone.

Naltrexone(Gaur) - 1.5-4.5mg/Kg.
Administered 25% intravenously and 75% subcutaneously. The actual dose of naltrexone is determined by the total dose of carfentanil given to immobilize the animal. Naltrexone is given in a ratio of 150mg naltrexone per 1mg of carfentanil. The animal will require approximately 5 minutes to roll into sternal recumbency and 10-15 minutes to stand and behave normally.

Naltrexone(Banteng) - 0.15-0.45mg/Kg
Administered as described above.

Emergency Drugs and Procedures

Few significant problems are likely to occur during these procedures. However, the following equipment and drugs will be available for potential emergencies.

30 mm stomach tube - bloat occurs very rarely in animals that have been fasted prior to immobilization. However, if it does occur, the stomach tube can be inserted through the mouth, down the esophagus and into the rumen to release the accumulated gas. Significant bloating may require ending the immobilization procedure.

Atropine - 0.1mg/Kg IV.
Atropine may be used in cases when the heart rate is less than 40 beats per minute.

Yohimbine - 0.05mg/Kg IV.
Yohimbine reverses the effects of xylazine. It may be used when the respiratory rate of the animal is less that 6 breaths per minute. Administration of yohimbine may require ending the procedure.

Epinephrine - 0.02-0.03mg/Kg IV.
Epinephrine is a cardiac stimulant and would only be administered in extreme emergencies such as cardiac arrest.

Post Immobilization Monitoring

During the 48 hours following immobilization, animals will rarely develop symptoms of renarcotization. In essence the immobilizing drug, carfentanil, is still present in their system and they may exhibit symptoms as if they are becoming immobilized again. These symptoms include sedation, pacing, vocalizing, ataxia and could include sternal recumbency in extraordinary cases.

All animals should be held in the immobilization enclosure for 48 hours following the procedures. Drinking water and food should be provided immediately following the procedures. Animals should be checked by observation frequently during this time and any unusual behavior noted and reported to the veterinarian.

Symptoms of renarcotization are easily treated by administration of 0.5mg/Kg naltrexone intramuscularly. The animals behavior should return to normal in 10-15 minutes after treatment with naltrexone.

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ASIAN WILD CATTLE CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP) WORKSHOP

WORKING DOCUMENT

October 1995

Report from the workshop held
21-25 July 1995
Chonburi, Thailand

Compiled by Workshop Participants

SECTION 3

TAXON DATA SHEETS

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Thailand population)
STATUS:
IUCN: Critically Endangered
Criteria based on: 1) Less than 250 individuals continuing to decline and all in one population (C2b). 2) Less than 50 mature individuals (D).
CITES: Appendix III (Nepal)

TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.

CURRENT DISTRIBUTION: Huai Kha Khaeng Wildlife Sanctuary
HISTORICAL DISTRIBUTION: All riverine areas in Central Thailand.
EXTENT OF OCCURRENCE: B, 101-5,000 km2; ~2,575 km2
AREA OCCUPIED: C, 501-2,000 km2; Approximately 50% of 2,575 km2 or 1,200 km2
NUMBER OF LOCATIONS: 1
POPULATION TRENDS: Stable, maybe slight increase
TREND OVER PAST 100 YEARS: Declining, extirpated from most of former range.
GENERATION TIME: Seven years?

WORLD POPULATION: <6,000 for the species; Thailand population: 50-100 animals of which ~20-40 are likely to be mature
REGIONAL POPULATION(S): 50 - 100 animals in one location. (10 in largest group)
DATA QUALITY: 3 - Informal field sightings; Anecdotal records from Theerapat Prayurasiddhi, Royal Forestry Department

RECENT FIELD STUDIES: Field study on habitat type, Faculty of Forestry 1992-1993
THREATS: Hunting, loss of habitat (burning), possibly disease transfer and hybridization with domestics.
TRADE: No trade known.
COMMENTS:
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Improved protection of Huai Kha Khaeng Wildlife Sanctuary, surveys, monitoring and taxonomic research.
PHVA: Not recommended for this species alone but a combined PHVA in recommended for Buffalo, Gaur and Banteng population in Huai Kha Khaeng Wildlife Sanctuary.
CAPTIVE PROGRAM RECOMMENDATION: Pending
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): None
SOURCES: Asian Wild Cattle Action Plan, Draft 1995
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Nepal population)
STATUS:
IUCN: Critically Endangered
Criteria based on: Less than 250 mature individuals continuing to decline and all in one population (C2b), less than 50 mature individuals (D).
CITES: Appendix III (Nepal listed as Bubulas arnee)
TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: Kosi Tappu Wildlife Reserve
HISTORICAL DISTRIBUTION: Permanent lowland riverine habitat.
EXTENT OF OCCURRENCE: B, 101-500 km2; 170 km2.
AREA OCCUPIED: B, 11-500 km2; ~100 km2.
NUMBER OF LOCATIONS: One
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Estimated 3% increase over two generations.
TREND OVER PAST 100 YEARS: Decline due to extirpation from former habitats.
GENERATION TIME: ~Seven years.
WORLD POPULATION: <6,000 for the species; Nepal population is ~110 individuals of which ~44-55 are mature.
REGIONAL POPULATION(S): Approx. 110 animals (from Heinen, 1993, new estimations from Department of National Parks, Nepal).
DATA QUALITY: (2) General field study conducted in 1988
RECENT FIELD STUDIES: 1988 Heinen, 1976 Dahmer
THREATS: Flooding (especially calves and adult females), possibly disease, human interference, loss of habitat and hybridization.
TRADE: No
COMMENTS: Current reserve does not appear to be best location for this population due to annual flooding. Feasibility study for trans-location needs to be conducted. The following concerns should be addressed: 1) The suitability of Royal Chitwan National Park as a site for reintroduction. 2) Why the former population in Chitwan National Park was extirpated. 3) What problems such as disease and contact with the domestic population would be encountered with trans-location to Chitwan National Park.

RECOMMENDATIONS:
RESEARCH MANAGEMENT: Monitoring, survey, and taxonomic studies
PHVA: No
CAPTIVE PROGRAM: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): 9.18; The taxonomic status of these animals needs to be clarified.
SOURCES: Heinen, J. (1993) Biol. Conserv. 65: 29-34.
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Central India population)
STATUS:

IUCN: Critically Endangered

Criteria based on: 1) A population decline of 80% from direct observation and a decline in extent of occupancy (A1a and A1c). 2) Less than 250 mature individuals and a severely fragmented population that is declining (C2a). 3) Less than 50 mature individuals (D).

CITES: Appendix III (Nepal listed as Bubulas arnee)

TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: Found in four reserves, three locations (but probably 4 subpopulations):

1) Indravati 1258 km2; Bhairamgarh 138 km2
2) Pamed 262 km2
3) Uddanti 247 km2

HISTORICAL DISTRIBUTION: Permanent lowland riverine habitat.
EXTENT OF OCCURRENCE: D, >20,000 km2.
AREA OCCUPIED: C, 501-2,000 km2; ~1,905 km2.
NUMBER OF LOCATIONS: Three locations (but probably 4 subpopulations).
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Three subpopulations have experienced major (80%) decline in the last 30 years. Nothing is known about the trend in Uddanti
TREND OVER PAST 100 YEARS: Major decline
GENERATION TIME: Seven years.
WORLD POPULATION: <6,000 for species; Central Indian population consists of ~50 animals of which ~20-25 are likely to be mature.
REGIONAL POPULATION(S):

Indravait (NP):	1988 30-50	
Bhairamgargh (WS):	1988 ~15	
Pamed (WS):	1988 ~25	
Indravait (NP), Bhairamgargh (WS) and Pamed (WS):		1992 27
Uddanti (WS):	1988 ~25	1992 25
Total:	1988 ~95-115	1992 ~50
Number mature:	1988 ~38-57	1992 ~20-25

DATA QUALITY: (2) General field study.
RECENT FIELD STUDIES: Census by Divekar (1988 and 1992)
THREATS: Loss of riverine areas (L), Hunting for tribal ritual (Hf), Potential disease transmission from domestic animals (D), human interference (I) and potentially hybridization (Hyb).
TRADE: None
COMMENTS: 1) Insurgency is a major threat because it makes patrolling and policing impossible. 2) Strong protection measures are required. 3) Development of conservation

education schemes are critical.

RECOMMENDATIONS:

RESEARCH MANAGEMENT: Surveys, monitoring and taxonomic studies

PHVA: Pending surveys

CAPTIVE PROGRAM RECOMMENDATION: No

LEVEL OF DIFFICULTY: 1

EXISTING CAPTIVE POPULATION (ISIS): 43.97.1; Their taxonomic status is very unclear and it is doubtful that they are from Central India.

SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan (Hedges, 1995); H.K. Divekar (pers. comm., 1995).

COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Northeast India (Assam) and Bhutan population)
STATUS:

IUCN: Endangered

Criteria based on: Less than 2,500 mature individuals (C1), population reduction (A2e).

CITES: Appendix III (Nepal listed as Bubulas arnee)

TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: The distribution is broken down into the following sub-populations:

1) Manas (Assam and Bhutan) 500 km2
2) Kaziranga and adjacent areas (Assam) 500 km2
3) Laokhowa and adjacent areas (Assam) 140 km2
4) Lakhimpur (Assam) 60 km2
5) Dibru-Saikhowa and adjacent areas (Assam and Arunachal Pradesh) 1300 km2
6) Balphakram (Meghalaya) 200 km2
7) Other scattered subpopulations (Assam)

HISTORICAL DISTRIBUTION: Riverine habitat in Assam, Northwest Bengal and nearby states.
EXTENT OF OCCURRENCE: D, >20,000 km2
AREA OCCUPIED: D, >2,000 km2; 1,800 km2
NUMBER OF LOCATIONS: 6 (see current distribution above)
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: 1,2,4,7 slightly (20%) declining. 2 and 5 slightly rising. 6 Stable
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: Seven years.
WORLD POPULATION: <6,000 for species; Northeast Indian population consists of ~2800 animals of which only ~1,100-1,400 are likely to be mature.
REGIONAL POPULATION(S): The distribution is broken down into the following sub-populations:

1) Manas (Assam and Bhutan) <1000 animals
2) Kaziranga and adjacent areas (Assam) >1100 animals
3) Laokhowa and adjacent areas (Assam) ~100 animals
4) Lakhimpur (Assam) >100 animals
5) Dibru-Saikhowa and adjacent areas (Assam and Arunachal Pradesh) ~500 animals
6) Balphakram (Meghalaya) Small subpopulation
7) Other scattered subpopulations (Assam) 30 animals

Total Population: Approx. 2800 (1995)
DATA QUALITY: Forest department estimates for 1 and 2; Choudhury (1994) and Choudhury (pers comm. 1995) for 3 thru 7.

RECENT FIELD STUDIES: Forest department survey in 1992 (Choudhury pers comm). Survey (Choudhury 1994). Survey in Dibru-Saikhowa and adjacent areas 1992 - 1994 (Choudhury, pers. comm., 1995).
THREATS: Insurgency; habitat degradation for 3,4,5 and 7; hunting of various kinds for 1,3,4,5,7; disease and hybridization

TRADE: Suspected but none documented
COMMENTS: Clarification /conformation of wild versus feral versus domestic is extremely important.
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Survey, monitoring and taxonomic studies
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1

EXISTING CAPTIVE POPULATION (ISIS): None, but many of those listed for central India are probably from Northeast India (Hedges, pers. comm., 1995).
SOURCES: Choudhury (1994) Oryx 28(1): 70-75; IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan (Hedges, 1995).
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Cambodia population)
STATUS:
IUCN: Data Deficient, Suspected Critically Endangered
Criteria based on: Population estimated at less than 50 mature individuals (D).
CITES: Appendix III (Nepal listed as Bubalus arnee)
TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: The buffalo is reported in the following locations: Virachy, Lomphat, Kulen-Promtep, Phnom-Kulen in Cambodia:
HISTORICAL DISTRIBUTION: Northern Cambodia
EXTENT OF OCCURRENCE: D, >20,000 km2
AREA OCCUPIED: Approx. 4,000 km2 ??
NUMBER OF LOCATIONS: 4
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Unknown
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: Seven years.
WORLD POPULATION: <6,000 for the species; this population unknown
REGIONAL POPULATION(S): 4 sightings by WPO in Lomphat, all other sightings by local people.
DATA QUALITY: Indirect information
RECENT FIELD STUDIES: Sun Hean (1995 June Field Study)
THREATS: Hunting (Khmer and some local), Habitat destruction and fragmentation (Logging), and human interference (insurgents/local minority groups), disease, and hybridization.
TRADE: Skulls/horns of unknown provenance for sale in regional markets.
COMMENTS: See subspecies sheets.
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Survey, Monitoring, Taxonomic research, Law Enforcement, Public Education
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): None
SOURCES: Sun Hean, 1995 (Pers Comm.) Forestry Department; IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan (Hedges, 1995).
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Vietnam population)
STATUS:
IUCN: Data Deficient, Suspected Critically Endangered
Criteria based on: 1) An observed reduction of 80% over the last ten years (A1a). 2) Population estimated at less than 50 mature individuals (D).
CITES: Appendix III (Nepal listed as Bubalus arnee)
TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: Yokdon National Park and Bugiamap Nature Reserve
HISTORICAL DISTRIBUTION: Central and South Vietnam.
EXTENT OF OCCURRENCE: Unknown
AREA OCCUPIED: B, <100 km2
NUMBER OF LOCATIONS: 2?
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Great decline
TREND OVER PAST 100 YEARS: Declining may go extinct.
GENERATION TIME: 7 Years
WORLD POPULATION: <6,000 for the species; this population unknown
REGIONAL POPULATION(S): Horns (1988) and footprints (1989) were found in Jokdon National Park. Local reports were made in 1992 from Bugiamap Nature Reserve.
DATA QUALITY: 4, indirect information
RECENT FIELD STUDIES:
THREATS: Habitat loss and fragmentation, Disease, Hybridization, Human interference and Hunting.
TRADE: Skulls/horns, usually of unknown provenance, for sale in regional markets.
COMMENTS: See subspecies sheets.
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Survey, monitoring, taxonomic research; Creation of cross-border reserve with Cambodia.
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): 27.23?
SOURCES: Le Vu Khoi (pers comm 1995); IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan, 1995
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Borneo)
STATUS:
IUCN: Data Deficient
Criteria based on:
CITES: Appendix III (Nepal listed as Bubalus arnee)
TAXONOMIC STATUS: Taxonomic status undecided.
CURRENT DISTRIBUTION: scattered; "free-ranging" of unknown origin
HISTORICAL DISTRIBUTION: Fairly certain formerly present
EXTENT OF OCCURRENCE: Unknown
AREA OCCUPIED: Unknown
NUMBER OF LOCATIONS: Unknown
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Unknown
TREND OVER PAST 100 YEARS: Unknown
GENERATION TIME: Seven years?
WORLD POPULATION: <6,000 for the species; this population unknown
REGIONAL POPULATION(S): Unknown
DATA QUALITY: Indirect information
RECENT FIELD STUDIES: None
THREATS: Hybridization, disease and habitat loss and fragmentation, hunting, human interference
TRADE: None reported
COMMENTS: Suspected feral population, not certain if Borneo is in the historic range of the species.
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Survey (along with other large mammals), Monitoring and Taxonomic studies
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): 4.10, Taxonomic status is unclear, they may be feral or even domestic; Unknown whether other captive populations exist.
SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan (Hedges, 1995).3
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Sri Lanka)
STATUS:
IUCN: Endangered
Criteria based on: Population estimates (C2a)
CITES: Appendix III (Nepal listed as Bubalus arnee)
TAXONOMIC STATUS: Taxonomic status undecided.
CURRENT DISTRIBUTION: 5 separate protected areas: 1) Wilpattu; 2) Somawathiya and Flood Plains; 3) Madura Oya/Nilgala/Gal Oya; 4) Ruhuna Complex; 5) Uda Walawe
HISTORICAL DISTRIBUTION: All suitable riverine habitat; unknown whether Sri Lanka is within historical range of species.
EXTENT OF OCCURRENCE: D, >20,000 km2
AREA OCCUPIED: D, >2,000 km2
NUMBER OF LOCATIONS: 6
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Current trend is unknown in areas 1,2,3,5,6; stable in area 4.
TREND OVER PAST 100 YEARS: Decreasing
GENERATION TIME: ~Seven years.
WORLD POPULATION: <6,000 for the species; The Sri Lankan population consists of ~3,000-3,500 animals of which 1,200-1,750 are likely to be mature. (Sri Lankan population is divided into 6 subpopulations).
REGIONAL POPULATION(S): 1) Wilpattu 160 (1960s); 2) Somawathiya and Flood Plains 150-250? (1994); 3) Madura Oya Nilgala Caloya 300-400? (1994); 4) Ruhuna Complex 2,000 (1992); 5) Uda Walawe 200-300?(1994) 6) Hurulu 50-100.
DATA QUALITY: 3, informal field sightings except Ruhuna where data quality is 1, reliable monitoring.
RECENT FIELD STUDIES: Ruhuna National Park (1991-1993)
THREATS: Interbreeding with feral stock, agricultural encroachment and political unrest, disease.
TRADE: None reported
COMMENTS: Suspected feral population, not known if Sri Lanka is in the historic range of the species.
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Conduct surveys for areas 1,2,3, and 5; monitoring and taxonomic studies.
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): 9.18; taxonomic status is very questionable.
SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan (Hedges, 1995).
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus bubalis (Laos Population)
STATUS:
IUCN: Data Deficient, but probably Critically Endangered/Suspected Extinct
Criteria based on:
CITES: Appendix III (Nepal listed as Bubalus arnee)
TAXONOMIC STATUS: See support documentation for discussion on taxonomic status.
CURRENT DISTRIBUTION: Some local reports in 1989 (may refer to feral animals)
HISTORICAL DISTRIBUTION: Unknown
EXTENT OF OCCURRENCE: Unknown
AREA OCCUPIED: Unknown
NUMBER OF LOCATIONS: Unknown
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Presumably declining
TREND OVER PAST 100 YEARS: Decreasing
GENERATION TIME: Seven years?
WORLD POPULATION: <6,000 for the species; The Lao PDR population unknown.
REGIONAL POPULATION(S): Some local reports (1989) of free ranging animals. There is a possibility this population is extinct.
DATA QUALITY: 4, Indirect information
RECENT FIELD STUDIES: None
THREATS: Hunting, habitat loss and fragmentation, war, disease, human interference, hybridization
TRADE: Reported along Thai-Lao and Lao Cambodian borders but may be feral animals.
COMMENTS:
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Surveys along with all other terrestrial large mammals, taxonomic studies and monitoring.
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY:
EXISTING CAPTIVE POPULATION (ISIS): Unknown, probably none in captivity
SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan (Hedges, 1995).
COMPILERS: Working Group 3

CAMP TAXON REPORT

SPECIES: Bubalus depressicornis (lowland anoa)
STATUS:

IUCN: Endangered

Criteria based on: Population reduction of at least 20% projected within the next 2 generations (A1), population estimated to be <2500 mature individuals (C1, C2a).

CITES: Appendix I

OTHER: USDI - Endangered

TAXONOMIC STATUS: This is a recognized species of wild Asian buffalo. Geographic variations are found in northern, southeastern and central Sulawesi populations; one species (depressicornis) and possibly 2 subspecies.
CURRENT DISTRIBUTION: Lowland areas of southeast, northern and central Sulawesi.
HISTORICAL DISTRIBUTION: All throughout Sulawesi, but now probably restricted only to northern, southeastern and central Sulawesi.
EXTENT OF OCCURRENCE: D, All of Sulawesi except southwestern portion, approximately 140,000 km2.
AREA OCCUPIED: D, <100,000 km2; 2/3 of extent of occurrence area is habitat unsuitable for lowland anoa.
NUMBER OF LOCATIONS: Unknown, but probably >10
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: unknown but believed to be declining.
TREND OVER PAST 100 YEARS:
GENERATION TIME: 6 - 8 years (reference: Mountain Anoa studbook)
WORLD POPULATION: In 1982 Dr John MacKinnon gave a 'guesstimate' figure of a few thousand; no information which would allow us to update his figure and the wild population should be listed as unknown, but likely to be declining.
REGIONAL POPULATION(S): unknown, but probably >10 subpopulations
DATA QUALITY: 5 no data available
RECENT FIELD STUDIES: None; there have been some preliminary studies in reserve areas but no complete survey.
THREATS: Hunting (food and trophies), human interference, loss of habitat and fragmentation.
TRADE: No international trade reported

COMMENTS: Information on lowland anoa is lacking. There is no defined population range and no current scientific study to gather information on natural history, population numbers, distribution, etc. Effective protection of known populations and existing habitat is required.

RECOMMENDATIONS:

RESEARCH MANAGEMENT: Taxonomic and morphological genetic studies, survey, monitoring, habitat management, limiting factors research, and life history

studies. It is also recommended that an information/education campaign be developed for the species.

PHVA: Yes

CAPTIVE PROGRAM RECOMMENDATION: Level 1: a captive population is recommended as a component of a conservation program. The correct species identification and subspecific status of the different animals needs to be clarified. Until then, the international studbook keeper recommends pairings only within each phenotype. Additional founders and/or germ plasm are needed to supplement the international captive population.

LEVEL OF DIFFICULTY: 1: least difficult. There is now an existing captive breeding program.

EXISTING CAPTIVE POPULATION (ISIS): ISIS data indicates 27.23 animals exist in captivity but a lot may be misidentified.

SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan (Hedges, 1995); Preparatory CAMP document (CBSG, 1995), and Briefing Book.

COMPILERS: Working Group 4

CAMP TAXON REPORT

SPECIES: Bubalus quarlesi (mountain anoa).
STATUS:

IUCN: Vulnerable/Endangered

Criteria based on: Population reduction of at least 20% within the next 10 years or 3 generations (A1)/Population unknown but very likely <2500 mature individuals and fragmented (C1, C2a).

CITES: Appendix I

OTHER: USDI - Endangered

TAXONOMIC STATUS: Probably a valid species of anoa but needs to be clarified. There is evidence of some geographic variation in color and size.
CURRENT DISTRIBUTION: Still occurs in most of its former range. Believed to be confined to highlands of Sulawesi but information from the Asian Wild Cattle Specialist Group Action Plan (Hedges, 1995) suggests it may extend down to sea level. It is also known to be present on Butung Island.
HISTORICAL DISTRIBUTION: Confined to Sulawasi
EXTENT OF OCCURRENCE: D, >20,000 km2 but not larger than 200,001 km2 throughout the whole of Sulawesi. Often individuals are not clearly identified as *quarlesi*.
AREA OCCUPIED: D, >2000 km2 but <200,000 km2
NUMBER OF LOCATIONS: Unknown except for information from Lore Lindu National Park. Available information indicates that population may be fragmented. Very probably >5 locations.
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Unknown but likely declining.
TREND OVER PAST 100 YEARS: unknown
GENERATION TIME: 6 - 8 years
WORLD POPULATION: Unknown, but number of mature animals is very likely to be <2,500.
REGIONAL POPULATION(S): Unknown but there probably >5.
DATA QUALITY: 5, no reliable data available
RECENT FIELD STUDIES: There have been some preliminary field studies in reserve areas but no complete survey (Foead, 1992).
THREATS: Loss of habitat (fragmentation), hunting (food and trophies), human interference, and local trade (parts, including skin).

TRADE: Not traded internationally.

COMMENTS: The geographic variations need to be clarified.

RECOMMENDATIONS:

RESEARCH MANAGEMENT: Taxonomic and morphological genetic studies, survey, monitoring to determine population information, limiting factors research, and life history studies, and habitat research to determine degree of fragmentation.
PHVA: Pending further data from surveys and research.
CAPTIVE PROGRAM RECOMMENDATION: Level 1: a captive population is recommended as a component of a conservation program. The correct species identity of individuals needs to be clarified until the question of subspecies is determined. The different phenotypes need to be kept separately.
LEVEL OF DIFFICULTY: Level 1: least difficult. There is now an existing captive breeding program.

EXISTING CAPTIVE POPULATION (ISIS): According to ISIS data, 4.2 animals exist in captivity but the actual number in captivity is much greater. A great many appear to be currently misidentified as Bubalus depressicornis.

SOURCES: Group discussion with Hedges, Groves, Read and compilers; Preparatory CAMP document and CAMP Briefing Book; IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan (Hedges, 1995); Nazir Foead (1992) Unpublished thesis. Forestry Faculty, UGM, Yogyakarta, Indonesia; comments received from Simon Hedges.

COMPILERS: Working Group 4

CAMP TAXON REPORT

SPECIES: Bubalus mindorensis (tamaraw)
STATUS:
IUCN: Endangered
Criteria based on: Extent of occurrence (B1, B2c), Number of mature individuals (D1), Population estimates (C).
CITES: Appendix I
OTHER: USDI - endangered
TAXONOMIC STATUS: This is a recognized species of wild Asian buffalo.
CURRENT DISTRIBUTION: Found on higher elevation of Mindoro Island, Philippines. Can also be found in areas of low elevation without established human activities.
HISTORICAL DISTRIBUTION: Observed in the lowlands of Mindoro Island prior to urbanization. Now found at higher elevations of the Island where there is insignificant human interference.
EXTENT OF OCCURRENCE: B, 101-5,000 km2; approximately 255,725 hectares (25% of the island).
AREA OCCUPIED: C, Approximately 230,000 hectares are protected but area occupied by tamaraw is very probably 501-2,000 km2. Found in 4 separate conservation areas namely Calavite Game Refuge and Bird Sanctuary (17,000 ha.), F.B. Harrison Game Refuge and Bird Sanctuary (123,000), Mts. Iglit-Baco National Park (75,445 ha.), Mt. Halcon - Eagle Pass (15,000 ha).
NUMBER OF LOCATIONS: 4 locations separated by local communities and areas developed by them for sources of livelihood such as agricultural farms and commercial cattle ranches.
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Stable for the past 10 years because of the concerted efforts of conservation groups.
TREND OVER PAST 100 YEARS: Declining. 10,000 estimated in 1900 (Harrison, 1969) declined to 1000 in 1949 (Manuel, 1957; Harrison, 1969). 200 in 1981 (PCARRD, 1981) and approximately 200-300 in 1993 (TCP 1993).
GENERATION TIME: 6-8 years
WORLD POPULATION: Upper end of the 300-400 range.
REGIONAL POPULATION(S): Calavite Game Refuge and Bird Sanctuary (25 individuals), F.B. Harrison Game Refuge and Bird Sanctuary (75 individuals), Mts. Iglit and Baco (182 wild and 7 captive individuals), Mt. Halcon - Eagle Pass (85 individuals).

DATA QUALITY: Reliable census information; This information is estimated separately from 3 sources: 1) 1981 and 1991 field census of Mts. Iglit-Baco National Park; 2) the Asian wild cattle specialist group action plan estimates 356 in 1987 (based on incidental observations of local villagers); and 3) Collado reported a 1993 estimate of upper end of the 300-400 range based on field studies conducted by TCP-UPLBFI and NGOs.

RECENT FIELD STUDIES: 1) Tamaraw census in Mts. Iglit-Baco National Park, Occ.

Mindoro and gene pool farm (Callo and Lustria, 1992); 2) Tamaraw habitat ecology (Callo, 1983); 3) Parasites of the captive tamaraw (Anunciado et al., 1995, in press); 4) Characteristics of tamaraw range (Rubio and Castillo, 1993); 5) The skull of the tamaraw (Masangkay et al., 1991); 7) Other ongoing research/field studies being undertaken by the ICP-UPLBFI.

THREATS: Human interference, loss of habitat due to cattle ranching, habitat fragmentation and hunting for food and trophies, disease. Nutrition and disease are threats to the captive population.
TRADE: None reported for the past 20 years.

COMMENTS: Human interference is still the biggest setback towards conservation efforts. Fragmentation of existing known population makes it difficult to protect and manage the tamaraw.
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Monitoring, habitat management, limiting factors research and life history studies. In addition, a field study should be conducted to document the biology and behavior of this species in the wild. Reproductive biology studies should be conducted on both wild and captive populations.
PHVA: Yes
CAPTIVE PROGRAM RECOMMENDATION: Level 1
LEVEL OF DIFFICULTY: Level 1

EXISTING CAPTIVE POPULATION (DENR): 4.2

SOURCES: 1) Field reports, DENR-RIV-B, 1994-1995; 2) Tamaraw Conservation Program Terminal Report, 1991-1993, UPLB Foundation, Inc.; 3) Callo, R.A., 1983, Ecological evaluation on the habitat of the Tamaraw in Mts. Iglit-Baco National Park, Occ. Mindoro, Master of Science Thesis UPLB, College, Laguna, Philippines; 4) Callo, R.A. and U.M. Lustria, 1992, Tamaraw census in Mt. Iglit, Occidental Mindoro and gene pool farm. Sylvatrop 2 (1):81-90; 5) PCARRD. 1981. State of the art - Tamaraw; 6) Kuehn, D.W. 1976. A field study of the Tamaraw. Pterocarpus 2(1):26-35; 7) DENR. 1993. Tamaraw evaluation report, DENR S.O. No. 93 series of 1993; 8) Harrison, T. 1969. The tamaraw and its survival. IUCN bull. 2(11):85-86; 9) Hedges, S. 1995, IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan.

COMPILERS: Working Group 4

CAMP TAXON REPORT

SPECIES: Bos gaurus gaurus (Indian gaur)
STATUS:
IUCN: Lower risk
Criteria based on:
CITES: Appendix I
OTHER: USDI - endangered
TAXONOMIC STATUS: A possibly valid subspecies
CURRENT DISTRIBUTION: Nepal, India and Bhutan
HISTORICAL DISTRIBUTION: Entire subcontinent except NW arid zone.
EXTENT OF OCCURRENCE: D, >20,000 km2; estimate: >700,000 km2
AREA OCCUPIED: D, >2,000 km2; estimate: 47,000 km2 protected areas; 177,000 km2 total.
NUMBER OF LOCATIONS: 102 protected areas contain 70% of the population; many locations outside protected areas.
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Increasing slightly in protected areas; decreasing outside.
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: ~8 years
WORLD POPULATION: 36,000-50,000 Indian gaur of which ~18,000-25,000 are likely to be mature.
REGIONAL POPULATION(S): Unknown
DATA QUALITY: Data for India -2 in protected areas, 3 outside these areas; Data for Nepal - 3.
RECENT FIELD STUDIES: A field study focusing on population numbers is being conducted for large herbivores in the tropical forests of Nagarahole, India (Nalkeri Preserve) by K. Ullas Karanth and Melvin E. Sunquist. Armstrong and Maskey report that there may be four herds (each comprising about 30 animals) in Chitwan National Park, Nepal (pers. comm., 1994). Survey in NE India (A. Choudhury, personal communication).
THREATS: Disease, hunting, habitat destruction/fragmentation.
TRADE: N/A
COMMENTS: Information on habitat based on State of Forest reports, 1993. India (A. Choudhury, personal communication). Nepal population is 250 - 350 gaur in 3 fragmented populations: Chitwan/Parsa (200-300), Udaipur (50 or less) and Bara (present but number unknown). According to Simon Hedges (IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan, 1995) the estimated population of 36,250-50,350 animals is very high compared with previous figures and, since it is largely based on forest department figures (not censuses/surveys using acceptable techniques), should be treated with caution. Hedges reports that K.U. Karanth thinks the population of Indian gaur is <10,000. This puts the Indian gaur into the Vulnerable category according to population estimate criteria (<10,000 mature animals and a severely fragmented population, C2a).
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Taxonomic studies and monitoring.
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: No
LEVEL OF DIFFICULTY: 1
EXISTING CAPTIVE POPULATION (ISIS): 0.3??
SOURCES: Tirtha Man Maskey, Nepal communicated through Joel Heinen, 1995; Anwaruddin Choudhury (pers. comm. 1995) from site visits, manuscript in preparation; census data to be forwarded.
COMPILERS: Working Group 1

CAMP TAXON REPORT

SPECIES: Bos gaurus laosiensis [readei] (Southeast Asian gaur)
STATUS:

IUCN: Critical/Endangered
Criteria based on: Extent of occurrence (B) and Population reduction (A1c,d; A2c,d).
CITES: Appendix I
OTHER: USDI - Endangered; Myanmar - protected

TAXONOMIC STATUS: Possibly a valid subspecies of gaur, often previously designated *B. g. readei.*
CURRENT DISTRIBUTION: Myanmar, Thailand, Laos, Cambodia, Vietnam, China
HISTORICAL DISTRIBUTION: See IUCN/SSC Asian Wild Cattle and Buffaloes Action Plan.
EXTENT OF OCCURRENCE: D, >20,000 km2; Extensive fragmentation (see accompanying chart)
AREA OCCUPIED: D, >2,000 km2
NUMBER OF LOCATIONS: ~43 locations in 6 countries; 8 locations in Myanmar
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: See chart
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: ~8 years
WORLD POPULATION: 6,800 - 8,400 of which ~3,400 - 4,200 are likely to be mature.
REGIONAL POPULATION(S): Totals for subpopulations by country: Thailand 900 - 1,000; Myanmar 3000; China 700 - 800; Laos 1,000; Cambodia 500- 600; Vietnam 1500 - 2,000
DATA QUALITY: Thailand 1; Myanmar 3; China 1; Laos 2; Cambodia 1; Vietnam 1
RECENT FIELD STUDIES: There are ongoing field studies in Thailand; A field study was conducted in China in 1993. No field studies in Myanmar.
THREATS: Thailand: Hunting (trophy, meat) and loss of habitat. Myanmar: Hunting (trophy, meat) and habitat fragmentation. Cambodia: poaching (trophy and meat), habitat loss; Vietnam: Hunting (food and trophy), loss of habitat, human interference.
TRADE: Illegal trade (trophies) reported throughout Southeast Asian mainland.
COMMENTS: See chart
RECOMMENDATIONS:

RESEARCH MANAGEMENT: For Thailand population: Taxonomic studies, monitoring, habitat management; For Myanmar population: Taxonomy, survey, monitoring and habitat management; For Cambodia, Vietnam and Laos: Taxonomy, survey, monitoring and habitat management.
PHVA: Yes
CAPTIVE PROGRAM RECOMMENDATION: Level 1; A coordinated effort needs to be made for all gaur subspecies, globally and in countries of origin.
LEVEL OF DIFFICULTY: level 2/3

EXISTING CAPTIVE POPULATION (ISIS): A captive program exists but the number of animals in captivity is unknown. Only one animal (male) in Myanmar at Yangon Zoo.

SOURCES: Thailand: Sompoad Srikosamatara and Varavudh Suteethorn, Populations of Guar and Banteng and their management in Thailand. (in press) Natural History Bulletin of the

Siam Society, 43(1) 1995); China: Ma, Yiqing, On the wild cattle in China, 1995. Vietnam: L.V. Khoi, The status of wild cattle and their conservation in Vietnam, 1995; Cambodia: Sun Hean, pers. comm., 1995; Myanmar: Oung and Win, pers. comm., 1995
COMPILERS: Working Group 1

BOS GAURUS LAOSIENSIS [READEI]
SUMMARY TABLE

	THAILAND	MYANMAR	LAOS	CAMBODIA	VIETNAM	CHINA
CURRENT ESTIMATED TOTAL POPULATION *(all animals, not mature individuals)* FOR COUNTRY	900-1000 est	3,000 est	< 1000 est	500-600 est (1995 SURVEY)	1500-2000 est	700-800 est
# OF SUB-POPULATIONS AND SIZE *(all animals, not mature individuals)* OF EACH	12 1) TYHKK WS 460 2) KY NP 100 3) TL NP 50 4) Phu Luang 30 5) Om Koi/Mae Tuen WS 50 6) Phu Kieow 30 7) SS NP 15 8) Phanom Dongrak 20 9) Khao Soi Dao/Khao Kitchakut Ang Ru Nai 30 10) Kaeng Krachan NP/Mae Nam Phachi WS 50 11) Khlong Nakha, etc. 50 12) Thung Salaeng Luang 30	~8-9 See map in ref. section for locations; No estimates available for subpopulation sizes.	? No information available	2-5 East side of Mekong, close to Vietnam (3? subpopulations) West side of Mekong N. of Cambodia, Close Thai border (2? subpopulations)	12-14? See map in reference section	3 1) Xishuangbanna 600 2) Simas 50-80 3) Cang Yucor 30-50
REASON FOR FRAGMENTATION	1) Agriculture development 2) Population growth 3) Development of "civilization"	1) logging activities 2) Agriculture development	agricultural development	Logging and agricultural development	agricultural development	In protected areas (not fragmented)
THREATS	1) Hunting for meat and trophy 2) Habitat disturbance	1) Hunting for meat and trophy	1) poaching, trophy 2) Agriculture development	1) poaching 2) habitat loss	1) hunting for food 2) hunting for trophy 3) habitat loss 4) human interference	No threats, animals protected in natural reserve. Population increased
DECLINE	60% in 20 years	40% in 12 years		50% in 5 years	70% in 10 years	
PREVIOUS POPULATION ESTIMATE FOR COUNTRY	1990: 1,000	5,000 (1983)			1983: 5,000	

CAMP TAXON REPORT

SPECIES: Bos gaurus hubbacki (Malayan gaur or seladang)
STATUS:

IUCN: Critically Endangered

Criteria based on: Population estimated at <250 mature individuals and the population is severely fragmented and declining (C2a).

CITES: Appendix I

OTHER: USDI - endangered

TAXONOMIC STATUS: This is a previously recognized subspecies of gaur. It may be a valid subspecies or a synonym of *B.g. laosiensis*.
CURRENT DISTRIBUTION: Peninsular Malaysia
HISTORICAL DISTRIBUTION: Southern Thailand and Peninsular Malaysia
EXTENT OF OCCURRENCE: D, >20,000 km2; estimate: More than 25,000 km2
AREA OCCUPIED: B, 11-500 km2; estimate: 100 km2; Central and Southern protected areas
NUMBER OF LOCATIONS: 3: 1) Enadau Rompin National Park - 100; Taman Negara National Park - 100; Belum Forest Reserve - 200; 50% of total population in unprotected areas.
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: 40% decline/15 years
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: ~8 years
WORLD POPULATION: ~400 (50% in protected areas) of which ~200 are likely mature individuals.
REGIONAL POPULATION(S): Endau Rompin (100), Taman Negara (100), Belum (200)
DATA QUALITY: 1 (1993 Department census; R. Mazlan, personal communication)
RECENT FIELD STUDIES: Belum report 1994.
THREATS: Loss of habitat, poaching, human interference and hunting for trophies.
TRADE: None reported
COMMENTS:
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Taxonomy, survey, monitoring, habitat management, husbandry

PHVA: Yes

CAPTIVE PROGRAM RECOMMENDATION: A level 1 program should be initiated.

LEVEL OF DIFFICULTY: 1

EXISTING CAPTIVE POPULATION (ISIS): 22
SOURCES: Dr. Razeem Mazlan, pers. comm., 1995; Eadau Rompin Management Plan 1993; Belum Report 1994; Taman Negara Report 1995 (on-going); Zaidnuul, pers. comm., 1995.
COMPILERS: Working Group 1

CAMP TAXON REPORT

SPECIES: Bos gaurus (forma) frontalis (gayal or mithan; Myanmar population)
STATUS:

IUCN: Vulnerable

Criteria based on: Population estimated at <10,000 mature individuals, probably declining, no subpopulation, (C2a, probably C1).

CITES: Not listed

OTHER: USDI - not listed

TAXONOMIC STATUS: Feral animals derived from domestic animals. Recognized as a subspecies in Myanmar.
CURRENT DISTRIBUTION: Myanmar, South China
HISTORICAL DISTRIBUTION: Unknown
EXTENT OF OCCURRENCE: D, >20,000 km2; estimate: 260,000 km2
AREA OCCUPIED: D, >2,001 km2
NUMBER OF LOCATIONS: 3 locations in Myanmar: 1) Upper Sagaing Division; 2) Chin State; 3) Kachin State; 1 location in Yunan province, South China
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Unknown but believed to be declining.
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: ~8 years
WORLD POPULATION: est. 3,500 of which <1750 are likely to be mature animals.
REGIONAL POPULATION(S): Myanmar: 3,000; South China: 300-500
DATA QUALITY: 3, Informal field sighting.
RECENT FIELD STUDIES: None
THREATS: Poaching for meat and habitat fragmentation
TRADE: Not known
COMMENTS: Although the external appearance of the mithan and offspring of gaur and domestic cattle are similar, in Myanmar the distribution of gaur and mithan overlap only in one area. Well funded agencies are invited to Myanmar to conduct genetic studies on these animals to get definitive differentiation. Myanmar will provide the necessary administrative support. Feral animals currently protected in Myanmar; India regards them as domestic animals, even if free-ranging.
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Taxonomy, survey, monitoring, habitat management.

PHVA: Pending further data from survey and other research.

CAPTIVE PROGRAM RECOMMENDATION: Level 3 (Myanmar)

LEVEL OF DIFFICULTY: 2, Moderate difficulty

EXISTING CAPTIVE POPULATION (ISIS): ISIS data indicate 20 animals exist in captivity. Total captive population estimated to be about 100 individuals.
SOURCES: Su Su Oung and Khin Than Win (personal communication, 1995); Census reports (to be forwarded) and field communications with locals.
COMPILERS: Working Group 1.

CAMP TAXON REPORT

SPECIES: Bos gaurus (forma) frontalis (gayal or mithan; Indian population)
STATUS:
IUCN: Not listed
Criteria based on:
CITES: Not listed
OTHER: USDI - not listed
TAXONOMIC STATUS: Origin unknown. This may be a hybrid between gaur and domestic cattle.
CURRENT DISTRIBUTION: India
HISTORICAL DISTRIBUTION: India
EXTENT OF OCCURRENCE: 60,000 km2
AREA OCCUPIED: Unknown
NUMBER OF LOCATIONS: Unknown
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Increasing
TREND OVER PAST 100 YEARS: Increasing
GENERATION TIME: 8 years
WORLD POPULATION: Unknown but likely >85,000
REGIONAL POPULATION(S): There are about 85,000 in Arunachal Pradesh, largest population in any state in India (Government of Arunachal Pradesh, 1995). Also found in Nagaland, Manipur and Mizoram.
DATA QUALITY: 3 (A. Choudhury, personal communication)
RECENT FIELD STUDIES: Brief survey (A. Choudhury, personal communication).
THREATS: Unknown
TRADE: None
COMMENTS: Bos gaurus frontalis are considered domestic animals, not wildlife, in India.
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Taxonomic studies
PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: A captive population is not recommended.
LEVEL OF DIFFICULTY: 2
EXISTING CAPTIVE POPULATION (ISIS): Many in zoos, villages.
SOURCES: Anwaruddin Choudhury (personal communication). Census reports to be forwarded.
COMPILERS: Working Group 1.

CAMP TAXON REPORT

SPECIES: Bos javanicus javanicus (Javan banteng)
STATUS:

IUCN: Endangered

Criteria based on: Population estimates, <2,500 mature individuals, fragmented population and decline projected (C2a).

CITES: Not listed

OTHER: Protected species in Indonesia

TAXONOMIC STATUS: Morphometric data (Groves, *pers com* ,1995) suggest that the Javan and SE Asian mainland forms are the same subspecies.
CURRENT DISTRIBUTION: Java, Bali
HISTORICAL DISTRIBUTION: Islands of Java and Bali (introduced to Bali?).

EXTENT OF OCCURRENCE: D, >20,000 km2; estimate: about 40,200 km^2.
AREA OCCUPIED: C, 501-2,000 km2; estimate: 1,800-3,000 km^2, but almost all occur in 1500-2000 km^2 (est) of suitable or available habitat in 9 protected areas.
NUMBER OF LOCATIONS: Probably 9-11 subpopulations on Java and 1 on Bali.
POPULATION TRENDS: Thought to be stable over the last 20 years (AWCSG draft action plan 1995). Probably slight decline at present.
TREND OVER PAST 100 YEARS: Decline.

GENERATION TIME: Not known, but probably ~6 years.
WORLD POPULATION: 1,000-2,000 individuals, but note that the mainland population may be included is this subspecies (see Taxonomic status above). This species as a whole consists of <10,000 individuals.
REGIONAL POPULATION(S): Java: Uncertain - but probably >1,000 and <2,000 of which ~500-1,000 are likely to be mature animals; Bali: Small numbers probably <50 (thought to be hybrids).
DATA QUALITY: 1,2,3 (highly variable)
RECENT FIELD STUDIES: See AWCSG Draft Action Plan 1995.

THREATS:
1) Habitat loss, decline in habitat quality and fragmentation.
2) Disease (particularly Jembrana virus) and disease transmitted from domestic cattle.
3) Hybridization with domestic cattle.
4) Hunting for meat or trophies.
4) Potentially trade in trophies (no trade currently identified)

TRADE: No information

COMMENTS:

RECOMMENDATIONS:

1) Censuses are needed to accurately determine the size of the banteng populations within protected areas on Java.
2) Research to clarify whether *Bos javanicus javanicus* and *Bos javanicus birmanicus* are the same subspecies (as suggested by morphometric data). This should be combined with research to investigate the genetic variation within and between the Javan and mainland banteng populations.

RESEARCH MANAGEMENT

1) After census data is available, experimental manipulation of the vegetation (such as making artificial grazing areas) in some parts of selected protected areas (for example Baluran N.P. or Alas Purwo Reserve in East Java). The effects of such habitat modification should be carefully monitored (by yearly censuses) to assess the positive or negative effects for the banteng and other species.
2) Inoculation programmes for domestic cattle in zones surrounding protected areas are recommended to reduce transmission of disease.
3) All populations within protected areas should be regularly monitored (at least every 2 years) using the best available methods, to allow accurate assessments of banteng population trends.

PHVA: No

CAPTIVE PROGRAM RECOMMENDATION: Not recommended. Resolve subspecific and genetic status of captive population of banteng.

LEVEL OF DIFFICULTY: 1, Least difficult

EXISTING CAPTIVE POPULATION (ISIS): Unknown, subspecific variation needs to be clarified.

SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan, Hedges, 1995. S. Hedges, M. Tyson *unpub. data.*, *pers com* with C. Groves and B. Read at Cattle CAMP workshop.

COMPILERS: Working Group 2

CAMP TAXON REPORT

SPECIES: Bos javanicus (birmanicus; Southeast Asian mainland population)

STATUS:

IUCN: Critically Endangered

Criteria based on: Population reduction: inferred and projected 80% decline/20 years (A1c,d; A2c,d).

CITES: Not listed

OTHER: USDI - Endangered; Myanmar - Protected

Thailand- Protected animal

Cambodia-Protected species

Vietnam-Protected species

Lao PDR- Prohibited category

Myanmar-Completely protected

TAXONOMIC STATUS: Controversial; formerly recognized as a subspecies, but morphometric data (Groves, *pers com* ,1995) suggest that the Javan and mainland forms are the same subspecies (Bos javanicus javanicus).

CURRENT DISTRIBUTION: Myanmar, Indochina, and Thailand

HISTORICAL DISTRIBUTION: NE India (Manipur), Bangladesh, Myanmar, Indochina, Thailand and Northern Malaysian peninsula (Kedah and Kelantan).

EXTENT OF OCCURRENCE: Population as a whole is >20,000 km2

Thailand:- look at map in Srikosamatara and Suteethon (1995) - >20,000 Sq.km

Cambodia -D, >20,000 Sq.km.

Vietnam -C, 5,000-20,000 sq.km.

Lao PDR -C, 5,000-20,000 Sq.km.

Myanmar -B, not more than 5,000 Sq.km.

AREA OCCUPIED: Uncertain; For population as a whole estimate is >2,000 km2

Thailand-D,>2,000 Sq.km.

Cambodia -D, >2,000 Sq.km.

Vietnam -C,

Lao PDR -D

Myanmar -D

NUMBER OF LOCATIONS: Thailand-9

Cambodia ->2

Vietnam -5

Lao PDR ->2

Myanmar -5-8: Bordering area of Bago Division; Lower Sagaing Division; Bordering area of Mandalay Division and upper parts of Shan State; Ayeyarwady Division; Kachin State

POPULATION TRENDS: Thailand- 80% decline over 20 years

Cambodia -70% decline over 20 years

Vietnam -60% decline over 20 years

Lao PDR -80% decline over 20 years
Myanmar - Believed to be declining

TREND OVER PAST 100 YEARS:- Declining
GENERATION TIME: Probably~6 years

WORLD POPULATION: SE Asian population 2,870-5,770 individuals of which <3,000 (~1,400-2,900) are likely to be mature.

REGIONAL POPULATION(S): subpopulation sizes totalled by country
Thailand ~470 (Srikosamatara and Suteethorn, 1995)
Cambodia ~700-1000 (Sun Hean, per. comm., 1995 survey/local hunting)
Vietnam ~200-300 (Le Vu Khoi, 1993)
Lao PDR ~500 (Srikosamatara per. comm., 1995); ~1000 (Boonchan, per. comm., 1995)
Myanmar <1000 (Srikosamatara, per. comm., 1995); 3,000 (Su Su Oung, per. comm., 1995)
TOTAL 2,870-5,770

DATA QUALITY:
Thailand- published (1)
Cambodia- Pers. comm., field work (2)
Vietnam- published (1)
Lao PDR- extracted from various published works (2)
Myanmar- informal field sighting (3).

RECENT FIELD STUDIES:
Thailand:
1. Ecological separation of Gaur and Banteng in Huai Kha Khaeng (HKK) Wildlife Sanctuary by Prayurasiddhi WCD, RFD
2. Population monitoring of gaur and banteng population in HKK by Srikosamatara, Mahidol University
3. Survey methods by Bhumpakphan, KU
Cambodia
1. General survey for banteng, kouprey and guar by Sun Hean, Wildlife Protected Office of Cambodia
Vietnam
1. The status of wild cattle and their conservation in Vietnam by Le Vu Khoi, Hanoi University
Lao PDR
1. general wildlife survey by Forestry Department and Wildlife Conservation Society
Myanmar
None

THREATS: Thailand- Hunting for trophy (Ht), Habitat loss (L), Trade for life animals and parts (T), Disease (D) footrot in case of HKK, Human disturbance (I), Nutrition (N)

Cambodia- Hf, Ht, W, Tt (horns), Lf (Logging)

Vietnam- Hf, Ht, L, Tp

Lao PDR- Ht, L, T

Myanmar- Hf, Ht, L

TRADE: Thailand-trade in horns still found around Uthai Thani Province

Cambodia- large scale trophy trade was also found in Lomphat area of Mondolkiri province, Eastern Cambodia (Oliver and Woodford, 1994)

Lao PDR- In 1991 and 1993, the total number of wild cattle trophies for sale along Thai-Lao border were 100 in 1991 and 36 in 1993 (Srikosamatara et al., 1992; Srikosamatara and Suteethorn, 1994).

Vietnam- trade in horn still found in 1987.

Myanmar- Not known; Trophies found on sale along Myanmar-Thai border in 1993.

RECOMMENDATIONS:

International: Add Bos javanicus to CITES Appendix I as soon as possible.

Thailand- 1. Campaign against the tradition of trophy collection.

2. Strong law enforcement against trophy possession especially around the protected areas with large populations of banteng.

3. Protected areas where there are high populations of banteng (e.g. Huai Kha Khang Wildlife Sanctuary) require more support especially man power and money.

4. Domestic cattle pose a threat to wild populations of banteng in Huai Kha Khang Wildlife Sanctuary, Om Koi WS and Dong Yai WS.

5. Banteng in possession of Khao Nam Phu Nature and Wildlife Education Center require appropriate management.

6. Banteng in possession of ZPO and RFD should be loaned for interbreeding to increase genetic variation (avoid inbreeding depression).

Cambodia- 1. Surveys of banteng in Northeast Cambodia are required

2. Law enforcement and public awareness are required

3. Add to CITES Appendix I

4. Required people capacity building. Training programs/more staff required.

Vietnam- 1. Required more survey on better habitats i.e. Southern VN.

2. Monitoring to determine population information (M)

3. Buffer zone development around the protected areas i.e. Yokdon National Park and some natural reserve areas.

Myanmar- 1. Survey, search and find (S)

2. Monitoring to determine population information (M)

3. Habitat management (Hm)

4. Taxonomy (T)

Lao PDR- 1. Regulate trophy trade along Thai-Lao border either by cooperation between Thai

and Lao officials, joining CITES and strong law enforcement.

2. Intensive survey for banteng population.
3. Set up protected areas specifically for banteng.

PHVA:

Thailand- Yes
Cambodia- Pending until more information from survey
Vietnam- Pending until more information from survey
Lao PDR- Pending until more information from survey
Myanmar- Pending until more information from survey

CAPTIVE PROGRAM RECOMMENDATION:

Thailand- Level 2
Cambodia- Pending until further information from survey
Vietnam- Pending until further information from survey
Lao PDR- Pending until further information from survey
Myanmar- Pending until further information from survey.

LEVEL OF DIFFICULTY: Thailand- Level 2; Myanmar- Level 3
EXISTING CAPTIVE POPULATION (ISIS): In addition to the ISIS figure of 29 individuals in captivity: Thailand- Chiangmai M4.F9; KKOZ M0.F1; RFD: Khao Nam Phu and Khao Kor M7.F6.

SOURCES: Srikosamatara, S. and Suteethorn, V. 1995. Populations of Gaur and Banteng and their Management in Thailand. Natural History Bulletin of the Siam Society Vol. 43(1) Le Vu Khoi (in manuscript) The Status of Wild Cattle and their Conservation in Vietnam; Srikosamatara et al., 1992; Srikosamatara and Suteethorn, 1994, Su Su Oung, per. comm., 1995; IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan, Hedges, 1995.

COMPILERS: Working Group 2

CAMP TAXON REPORT

SPECIES: Bos javanicus lowi (Bornean banteng)
STATUS:

IUCN: Endangered

Criteria based on: Less than 2,500 mature individuals and continuing decline of at least 20% within 2 generations, and sever fragmentation (C1, C2a)

CITES: Not listed

OTHER: USDI - endangered

TAXONOMIC STATUS: Possibly a valid subspecies
CURRENT DISTRIBUTION: Kalimantan, Sabah, Sarawak
HISTORICAL DISTRIBUTION: Riverine areas and alluvial plains throughout Borneo
EXTENT OF OCCURRENCE: D, larger than 20,001 km2
AREA OCCUPIED: D, larger than 2,001 km2
NUMBER OF LOCATIONS: >8?
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: Sabah-eliminated in some areas; Brunei-extinct; Kalimantan-probably extinct in central Kalimantan.
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: no data, but probably ~6 years
WORLD POPULATION: For the species <10,000; this population probably <1,500 of which <750 are mature.
REGIONAL POPULATION(S): Unknown, presumably low numbers.
DATA QUALITY: 3, Many informal sightings
RECENT FIELD STUDIES: Current surveys in Sabah of Rhino and banteng occurrence by WCS (pers. comm., S. Srikosamatara).
THREATS: Loss of habitat (logging, fragmentation, conversion to oil palm plantation), human interference and hybridization with domestic cattle, hunting for trophies.
TRADE: None reported
COMMENTS: The major threats to this subspecies are presumably the small size and fragmentation of the population and habitat loss, and interbreeding with domestic cattle.
RECOMMENDATIONS:

RESEARCH MANAGEMENT: Survey areas where banteng are thought to still exist based on current available (poor quality) data. Collect information on hunting pressure and the presence of any trade in parts. Arrange for the collection of skulls and other material from dead wild banteng (by national park authorities) to assist in determining their taxonomic status. Habitat management.

PHVA: Pending (census data and subspecific status assessment)

CAPTIVE PROGRAM RECOMMENDATION: Pending collection of census and taxonomic information

LEVEL OF DIFFICULTY: 2

EXISTING CAPTIVE POPULATION (ISIS): None in captivity
SOURCES: AWCSG Draft Action Plan
COMPILERS: Working group 2

CAMP TAXON REPORT

SPECIES: Bos mutus (Wild yak, also known as Bos grunniens)
STATUS:
IUCN: Vulnerable
Criteria based on: Population reduction (A1d,A2d) and Population estimate (C)
CITES: Appendix I
OTHER: USDI - endangered
TAXONOMIC STATUS:
CURRENT DISTRIBUTION: 4 provinces of China, including Tibet, and India.
HISTORICAL DISTRIBUTION: See Asian Wild Cattle and Buffaloes Draft Action Plan, Hedges, 1995.
EXTENT OF OCCURRENCE: D, >20,000 km2
AREA OCCUPIED: D, >2,000 km2; estimate: 277,000km2
NUMBER OF LOCATIONS: 4 in China and 2 in India; China: 1) Aunren - 300; 2) Zhongba - 800; 3) Khunlun Mt. area - 13,000; 4) Qilian Mt. Area - 2,000.
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS: estimated 40% decrease/20 years.
TREND OVER PAST 100 YEARS: Declining
GENERATION TIME: 8 Years (estimated)
WORLD POPULATION: 16,000 - 20,000 (census 1987 - 1990), therefore <10,000 mature animals.
REGIONAL POPULATION(S): China: 16,000 - 20,000; India: a few
DATA QUALITY: 1, 1990 census; Investigation by Forest Department of Tibet. 3 for India.
RECENT FIELD STUDIES: 1995 field study by Piao and Ma
THREATS: Loss of habitat due to fragmentation, interspecific competition with domestic wildlife, hunting for food and catastrophe.
TRADE: Commercial hunting a threat in China, no international trade reported.
COMMENTS:
RECOMMENDATIONS:
RESEARCH MANAGEMENT: Taxonomic studies, survey, monitoring, habitat management and husbandry research.
PHVA: Yes
CAPTIVE PROGRAM RECOMMENDATION: Level 1
LEVEL OF DIFFICULTY: 3, Most difficult
EXISTING CAPTIVE POPULATION (ISIS): 2.2
SOURCES: Ma, Yiqing, One the wild cattle in China, 1995; Ren-zhu and Ma, Yiqing, Current situation of wild yak population in China, 1995; Schaller G. and Liu W. (in press) Distribution and status of wild yak, Bos gunniens. Biol. Cons. 1995; Choudhury, pers. comm., 1995; Miller D.J., R.B. Harris and C.Q. Cai Wild yaks and their conservation in the Tibetan Plateau. Proceedings of the First International Congress on Yak, 1994 p. 27-35.
COMPILERS: Working group 1

CAMP TAXON REPORT

SPECIES: Bos sauveli (kouprey)

STATUS:

IUCN: Critically endangered
Criteria based on: Population reduction (A2d), Population estimates (C1,C2,D)
CITES: Appendix I
OTHER: USDI - endangered
Thai - Reserved animal
Cambodia - endangered
Lao PDR - Prohibited animal
Vietnam - endangered.

TAXONOMIC STATUS: This is a recognized species of Asian wild cattle.
CURRENT DISTRIBUTION: Northern and NE Cambodia and adjacent parts of Thailand, Southern Lao PDR and SW Vietnam.
HISTORICAL DISTRIBUTION: See map 17.1 in the AWCSG Draft action plan - southern boundary of historical range should be moved further south (to include information from Olivier and Woodford (1994) and Sun Hean's June-July 1995 survey.
EXTENT OF OCCURRENCE: D, >20,000 km^2.
AREA OCCUPIED: D, >2,000 km2; Total area occupied: 13,242 km2. Perhaps Thailand and Lao PDR;
Cambodia: NE Cambodia, E of Mekong River (close to Vietnam, Lao PDR) 4126 km^2.
N Cambodia, N of Mekong River (close to Thailand and Lao PDR) 7,556 km^2.
Vietnam: 1560 km2 within 4 Protected Areas.
NUMBER OF LOCATIONS: at least 2
POPULATION TRENDS- % CHANGE IN YEARS OR GENERATIONS:
80% decline over 40 years.
TREND OVER PAST 100 YEARS: declining.
GENERATION TIME: No Data.
WORLD POPULATION: Unknown, but likely to be <100 individuals, of which <50 are likely to be mature, and the population is decreasing based on anecdotal field reports by Cambodians, Thais, Laos and Vietnamese who have documented the existence of the animals using evidence from recent skulls (trophy heads) and footprints.
REGIONAL POPULATION(S): probably at least two, sizes unknown.
DATA QUALITY: 2,3,4: Different data quality in parts of range.
RECENT FIELD STUDIES: See list in AWCSG Draft Action Plan, but add:
Sun Hean's (Cambodia) expedition (June-July 1995) in Mondolkiri province, West of O Phlay. Tracks (footprints) of 2 kouprey were found. No kouprey were seen.

THREATS: 1) Genetic problems (G)
2) Hunting for trophies (Ht)

3) Trade in parts [horns] (Tp)
4) Habitat loss (Lf) fragmentation.
5) War (W)

COMMENTS: Major threats to this species are the small size and fragmentation of the population, habitat loss and intense hunting to supply the trophy trade. Additionally, contact with domestic animals has historically posed disease threats. This is not thought to be a current threat. Kouprey are separate from gaur and banteng herds based on evidence from tracks (Sun Hean, pers. comm., 1995). However, according to Simon Hedges (pers. comm., 1995) this report is contradicted by all other reports, historical and recent.

TRADE: Illegal trophy trade through the Thai border and other range states (Srikosamatara et al., 1992; and Srikosamatara and Suteethorn, 1994; Hedges, 1995).

RECOMMENDATIONS:

Recommendation 1. Surveys to find evidence of kouprey presence in the following areas. [(N)= new area previously unsurveyed. All other areas listed have been surveyed in the past but require further survey effort]

Cambodia:	1) Virachey (N)
	2) Lomphat (completely survey)
	3) Phnom Prich [ground survey needed]
	4) Kulen Promtep (N) [security problems]
Vietnam:	1) Mon rai (Kontum province)
	2) Yokdon - Teo Teo of Easup district (Daklak province)
	3) Quang xuyen - Bugiamap (Song Be prov.)
Thailand:	1) National Reserved forest - Buntarik
	2) Phanom Dong Rak Wildlife Sanctuary (N)
	3) Huai Sala Wildlife Sanctuary
Lao PDR	1) Attapeau Province (N)
	2) Sekong Province (N)

Recommendation 1.2

Creation of a full-time kouprey survey team as suggested in the AWCSG Draft Action Plan.

Recommendation 2. Develop strong international kouprey conservation programs in Cambodia, Vietnam, Thailand and Lao PDR.

Expand existing protected areas and develop new protected areas to allow active wildlife management of kouprey in the following areas. It is specifically recommended that: Area 1 in Cambodia be connected with Area 1 in Vietnam and Areas 1 and 2 of Laos PDR; Areas 2,3,4 in Cambodia be connected to the corresponding Areas 2,3,4 in Vietnam; Areas 5,6,7 in Cambodia be connected with the respective Areas 1,2,3 in Thailand.

Cambodia:	1) Virachey 2) Lomphat 3) Phnom Prich 4) Phnom Nam Lyr 5) Bantreay chmar 6) Kulen Promtep 7) Preah Vihear
Vietnam:	1) Mon rai protected area (Nature Reserve) 2) Yok don National Park 3) Quang Xuyen nature reserve 4) Bu gia map nature reserve
Lao PDR:	1) Attapeau province 2) Sekong province
Thailand:	1) Huay Sala Wildlife Sanctuary 2) Phnom Dong Rak Wildlife Sanctuary 3) National reserved forest - Buntarik

[should be set up as a wildlife sanctuary]

Recommendation 3. Strongly lobby Thai, Cambodian, Vietnamese and Loa PDR governments to cease illegal logging activities along their borders. This is particularly urgent in the vicinity of Yok don and Lomphat region and the Virachey/Mon rai/Selad PDR areas

PHVA: No
CAPTIVE PROGRAM RECOMMENDATION: Pending (survey information required first).
LEVEL OF DIFFICULTY: 3
EXISTING CAPTIVE POPULATION (ISIS): There are no captive animals.

SOURCES: IUCN/SSC Asian Wild Cattle and Buffaloes Draft Action Plan, Hedges, 1995; Sun Hean (pers. comm., 1995); Olivier and Woodford (1994); Srikosamatara et al., 1992; Srikosamatara and Suteethorn, 1994; Le Vu Khoi (pers. comm., 1995).

COMPILERS: Working Group 2

ASIAN WILD CATTLE CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP) WORKSHOP

WORKING DOCUMENT

October 1995

Report from the workshop held
21-25 July 1995
Chonburi, Thailand

SECTION 4

APPENDICES

APPENDIX I: CONSERVATION ASSESSMENT AND MANAGEMENT PLANS

Introduction

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

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

Conservation Assessment and Management Plans (CAMPs)

Within the Species Survival Commission (SSC) of IUCN-The World Conservation Union, the primary goal of the 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 scientifically-based processes, on both a global and regional basis, with the goal of facilitating an integrated approach to species management for conservation. One of these tools is called Conservation Assessment and Management Plan (CAMP).

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

In addition to management in the natural habitat, conservation programs leading to viable populations of threatened species may sometimes need a captive component. In general, captive populations and programs can serve several roles in holistic conservation: 1) as genetic and demographic reservoirs that can be used to reinforce wild populations 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) as living ambassadors that can educate the public as well as generate funds for *in situ* conservation.

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

The CAMP Process

The CAMP process itself is intensive and interactive and is unique in its ability to facilitate objective and systematic prioritization of research and management actions needed for species conservation, both *in* and *ex situ.* Workshop participants develop the assessments of risks and formulate recommendations for action using a spreadsheet with columns that require participants to provide data on the status of populations and habitat in the wild as well as recommendations for intensive conservation action. The spreadsheet is augmented with a Taxon Data Sheet for each taxon under review. Taxon Data Sheets provide documentation of reasoning behind recommendations, and include elaboration of data that does not fit into the spreadsheet format as well as details of other pertinent information.

During a CAMP workshop, the wild and captive status for each taxon under consideration are reviewed, on a taxon-by-taxon basis (usually at the subspecies level). For each taxon, there is an attempt to estimate the total population. It is often very difficult, even agonizing, to be numerate because so little quantitative data on population sizes and distribution exists. However, it is frequently possible to provide order-of-magnitude estimates, especially whether the total population is greater or less than the numerical thresholds for the population data used in determining categories of threat. CAMP spreadsheets include a "data quality" column so that "guesstimates" can be distinguished from population estimates based on solid documentation. The CAMP process attempts to be as quantitative or numerate as possible for two major reasons:

- Action plans ultimately must establish numerical objectives for population sizes and distribution if they are to be viable.
- Numbers provide for more objectivity, less ambiguity, more comparability, better communication and hence cooperation.

Information about population fragmentation and trends, distribution, as well as habitat changes and environmental stochasticity also are considered.

The CAMP process utilizes information from SSC Action Plans that may already have been formulated by the taxon-based Specialist Groups as well as additional data, published and

unpublished, from experts on the taxa. CAMPs have been endorsed by the SSC and by BirdLife International as the logical first step toward the development of taxonomic Action Plans where they do not yet exist.

For each taxon reviewed, three kinds of assessments/recommendations are made:

1) assigning taxa to New IUCN Red List Category of Threat;
2) making recommendations for research and management activities to contribute to the taxon's conservation. These recommendations aim to more fully integrate recommended research and management actions and known threats. Research management can be defined as an interactive management program including a strong feedback loop between management activities, evaluation of their effectiveness, and the response of the species;
3) making recommendations for captive programs that can contribute to the conservation of the taxon. These form the foundation for development of Global Captive Action Recommendations (GCARs) and regional strategic captive collection plans for the zoo and aquarium community.

The CAMP process uses a conservative taxonomic approach. In most cases, initial risk assessment and management recommendations are made in terms of the maximal distinction among possible "subspecies" until taxonomic relationships are better elucidated. Splitting rather than lumping maximizes preservation of options. Taxa can always be merged ("lumped") later if further information invalidates the distinctions or if biological or logistic realities of sustaining viable populations precludes maintaining taxa as separate units for conservation.

New IUCN Red List Categories

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

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

The categories of Critical, Endangered, and Vulnerable are all nested (i.e., if a taxa qualifies for Critical, it also qualifies for Endangered and Vulnerable). The New IUCN Red List Categories are:

EXTINCT (EX)

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

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

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

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

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

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

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

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

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

Captive Populations
Today, as more and more species are threatened with population declines, cooperative recovery programs, including both zoos and the private sector, may provide a major avenue for survival. This cooperation must include support for field research, habitat conservation, as well as public education.

When *ex situ* management was recommended, the "level" of captive programs was developed, reflecting status, prospects in the wild, and taxonomic distinctiveness. The captive levels used during the Asian Wild Cattle CAMP are defined below.

Level 1 (1) - A captive population is recommended as a component of a

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

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

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

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

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

The Review Process for CAMPs

The results of the initial CAMP workshops are reviewed: 1) by distribution of a preliminary draft to workshop participants; 2) by distribution to a broader audience which includes wildlife managers and regional captive programs worldwide; 3) at regional review sessions at various CBSG meetings and workshops, utilizing local expertise with the taxonomic group in question. Thus CAMP workshops are part of a continuing and evolving process of developing conservation and recovery plans for the taxa involved. The CAMP review process allows extraction of information from experts worldwide. In nearly all cases, follow-up workshops are required to consider particular issues in greater depth or on a regional basis. Moreover, some form of follow-up will always be necessary to monitor the implementation and effectiveness of the recommendation resulting from the workshop. In many cases a range of PHVA workshops result from the CAMP workshops.

ASIAN WILD CATTLE
CONSERVATION ASSESSMENT AND MANAGEMENT PLAN (CAMP)
TAXON DATA REPORT CATEGORIES
20 April 1995

The Conservation Assessment and Management Plan (CAMP) taxon data report 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 Sheet 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.

SCIENTIFIC NAME: Scientific names of extant taxa: genus and species (or subspecies where appropriate).

TENTATIVE IUCN: Tentative Status according to the New IUCN Red List criteria (see Table 1 and additional materials)

CR = Critically Endangered
EN = Endangered
VU = Vulnerable
CD = Conservation Dependent
LR = Low Risk
DD = Data Deficient
NE = Not Evaluated

CRITERIA BASED ON: Indicate which of the New IUCN Red List criteria were used to assign a category of threat:

PR = Population reduction
EO = Extent of occurrence
PE = Population estimates
NM = Number of mature individuals
PX = Probability of extinction

CITES: List the CITES Appendix on which the species is listed, if appropriate.

OTHER: List whether the species has been assigned threatened status in other venues, e.g., nationally or in other conservation assessments.

TAXONOMIC STATUS: This indicates the taxonomic status of the extant taxa. Taxonomic uncertainties may be discussed in this section. Subspecies not considered separately should be listed here along with their distribution.

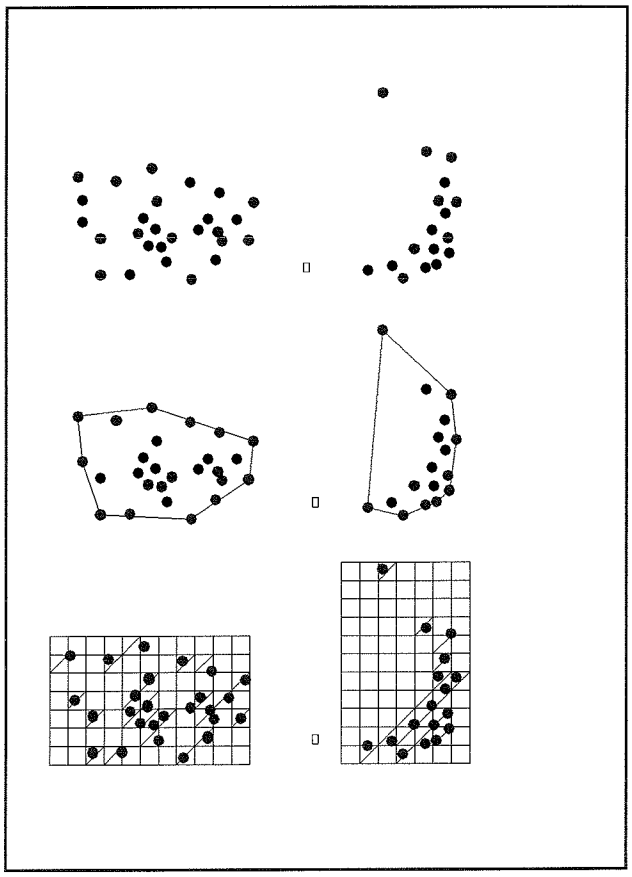
CURRENT DISTRIBUTION: List the geographical extent of locations of the species.

HISTORICAL DISTRIBUTION: List the historical distribution of the species

EXTENT OF OCCURRENCE: List the actual size of the area in which the species occurs, if possible. Also list the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred, or projected sites of present occurrence of a taxon, excluding cases of vagrancy (Figure 1). This measure does not take account of discontinuities or disjunctions in the spatial distributions of taxa. Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

A: < 100 km2
B: 101 km2 - 5,000 km2
C: 5,001 km2 - 20,000 km2
D: larger than 20,001 km2

AREA OF OCCUPANCY: List the area within the 'extent of occurrence' which is actually occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of a taxon (e.g., colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relent biological aspects of the taxon. The criteria include values in km2, and thus to avoid errors in classification the area of occupancy should be measured on grid squares or equivalents which are sufficiently small (see Figure 1).



A: < 10 km2
B: 11 km2 - 500 km2
C: 501 km2 - 2,000 km2
D: larger than 2,001 km2

Fig. 1. Two examples of the distinction between the extent of occurrence and area of occupancy. (a) and (b) are the spatial distribution of known, inferred, or projected sites of occurrence. (c) and (d) show one possible boundary to the extent of occurrence, which is the measured area within this boundary. (e) and (f) show one measure of area of occupancy which can be measured by the sum of the occupied grid squares.

 # LOCATIONS: Note the number of locations in which the taxon is found. If the population is fragmented, indicate "F" after the number of locations.

POPULATION TRENDS - % CHANGE IN YEARS OR IN GENERATIONS: If possible, list the trend of the population (stable, declining, or increasing). If possible, list the percent of change over a particular time frame (e.g., 10 or 20 years) or number of generations. Specify the number of years or generations over which the decline has occurred, e.g., 10%/2g or 20%/20 yrs.

GENERATION TIME: Indicate the number of years in a generation. A generation is defined as the average age of parents in the population.

WORLD POPULATION: List the estimated numbers of individuals in the wild. If specific numbers are unavailable, estimate the general range of the population size.

REGIONAL POPULATION(S): List the estimated number of individuals in any particular region for which there are data, followed by the location.

DATA QUALITY: List the actual age of the data used to provide the population estimates. Also list the type of data from which the estimates are provided.
1 = Reliable census or population monitoring
2 = General field study
3 = Informal field sightings
4 = Indirect information (trade numbers, habitat availability).
5 = No data available
Any combination of above = different data quality in parts of range.

RECENT FIELD STUDIES: List any current or recent field studies, the name of the researcher and the location of the study.

THREATS: List immediate or predicted events that are or may cause significant population declines. These may include:
A = Aircraft
C = Climate
D = Disease
Dp = Decline in prey species
Dr = Drowning
F = Fishing
G = Genetic problems
H = Hunting
Hf = Hunting for food
Hm = Hunting for medicine
Ht = Hunting for trophies
Hyb = Hybridization
I = Human interference, persecution, or disturbance

Ic = Interspecific competition
Ice = Interspecific competition from exotics
Il = Interspecific competition with domestic livestock
L = Loss of habitat
La = Loss of habitat because of exotic animals
Lf = Loss of habitat because of fragmentation
Lp = Loss of habitat because of exotic plants
M = Marine perturbations, including El Niño and other shifts
N = Nutritional disorders or problems
P = Predation
Pe = Predation by exotics
Ps= Pesticides
Pl= Powerlines
Po= Poisoning
Pu= Pollution
S = Catastrophic events
  Sd: drought
  Sf: fire
  Sh: hurricane
  St: tsunami
  Sv: volcano
T = Trade for the live animal market
  Tp: trade for parts, including skins
W = War

TRADE:
Was the species present in Trade according to CITES records? If so, list year(s).

COMMENTS: Note any additional information that is important with respect to the conservation of the species.

RECOMMENDATIONS:

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

T = Taxonomic and morphological genetic studies
Tl = Translocations
S = Survey - search and find

M = Monitoring - to determine population information
H = Husbandry research
Hm = Habitat management - management actions primarily intended to protect and/or enhance the species' habitat (e.g., forest management)
Lm = Limiting factor management - "research management" activities on known or suspected limiting factors. Management projects have a research component that provide scientifically defensible results.
Lr = Limiting factor research - research projects aimed at determining limiting factors. Results from this work may provide management recommendations and future research needs
Lh = Life history studies
O = Other (record in detail on taxon data sheet)

PHVA: Is a Population and Habitat Viability Assessment Workshop recommended to develop an intensive management/recovery plan for the species?
Yes, No or Pending further data from surveys or other research.

CAPTIVE PROGRAM RECOMMENDATIONS:

Level 1 (1) - A captive population is recommended as a component of a conservation program. This program has a tentative goal of developing and managing a population sufficient to preserve 90% of the genetic diversity of a population for 100 years (90%/100).

Level 2 (2) - Similar to the above except a species/subspecies management plan would include periodic reinforcement of captive population with new genetic material from the wild.

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

No (N) - A captive program is not currently recommended as a demographic or genetic contribution to the conservation of the species/subspecies.

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

LEVEL OF DIFFICULTY: What is the level of difficulty in maintaining the species in captive conditions?

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

2 = Moderate difficulty. Techniques are only partially in place for capture,

maintenance, and propagation of similar taxa in captivity, and many captive techniques still need refinement.

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

EXISTING CAPTIVE POPULATION: Number of individuals in captivity according to the International Species Information System. Please add other information, when available, as the numbers listed consist of only a portion of the captive population.

SOURCES: List sources used for information for the above data. (Author's name, year, title of article or book, journal, issue, and page numbers).

COMPILERS: List the names of the people who contributed information for this taxon data sheet.

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IUCN RED LIST CATEGORIES

Prepared by the

IUCN Species Survival Commission

As approved by the
40th Meeting of the IUCN Council
Gland, Switzerland

30 November 1994

IUCN RED LIST CATEGORIES

I) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their introduction these categories have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter & Fitter 1987), which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1989 with a request from the SSC Steering Committee to develop a new approach that would provide the conservation community with useful information for action planning.

In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an explicit, objective framework for the classification of species according to their extinction risk.

The revision has several specific aims:

- to provide a system that can be applied consistently by different people;
- to improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction;
- to provide a system which will facilitate comparisons across widely different taxa;
- to give people using threatened species lists a better understanding of how individual species were classified.

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

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

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

2

Version 2.1: IUCN (1993)

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

Version 2.2: Mace & Stuart (1994)

Following further comments received and additional validation exercises, some minor changes to the criteria were made. In addition, the Susceptible category present in Versions 2.0 and 2.1 was subsumed into the Vulnerable category. A precautionary application of the system was emphasised.

Final Version

This final document, which incorporates changes as a result of comments from IUCN members, was adopted by the IUCN Council in December 1994.

All future taxon lists including categorisations should be based on this version, and not the previous ones.

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

References:

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

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

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

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

Mace, G. M. & S. N. Stuart. (1994) "Draft IUCN Red List Categories, Version 2.2". Species 21-22: 13-24.

II) Preamble

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

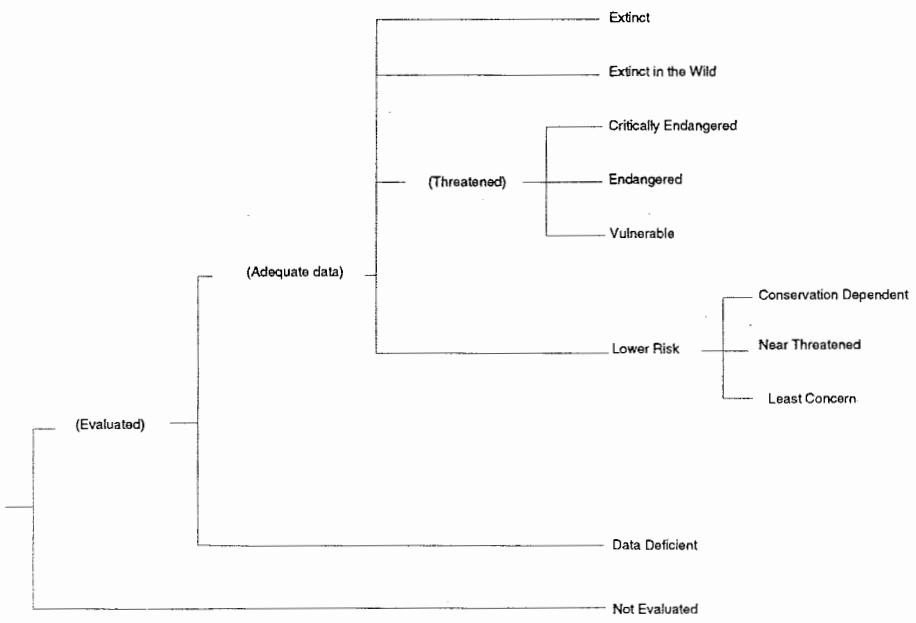
1. **Taxonomic level and scope of the categorisation process**

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

2. **Nature of the categories**

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

Figure 1: Structure of the Categories



4

3. **Role of the different criteria**

For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. Each species should be evaluated against all the criteria. The different criteria (A-E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for certain taxa(some taxa will never qualify under these however close to extinction they come), there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear which criteria are appropriate for a particular species in advance, each species should be evaluated against all the criteria, and any criterion met should be listed.

4. **Derivation of quantitative criteria**

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

5. **Implications of listing**

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

Extinction is assumed here to be a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than in a lower one (without effective conservation action). However, the persistence of some taxa in high risk categories does not necessarily mean their initial assessment was inaccurate.

6. **Data quality and the importance of inference and projection**

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

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

7. **Uncertainty**

The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the

information that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the estimate (providing it is credible) that leads to listing in the category of highest risk.

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

8. **Conservation actions in the listing process**

The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it. In cases where it is only conservation action that prevents the taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon require conservation action even if it is not listed as threatened.

9. **Documentation**

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

10. **Threats and priorities**

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

11. **Use at regional level**

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories, which are aimed at including taxa that are threatened at regional or national levels (but not necessarily throughout their global ranges), are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa classified as Vulnerable on the basis of their global declines in numbers or range might be Lower Risk within a particular region where their populations are stable. Conversely, taxa classified as Lower Risk globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at the margins of their global range. IUCN is still in the process of developing guidelines for the use of national red list

categories.

12. Re-evaluation

Evaluation of taxa against the criteria should be carried out at appropriate intervals. This is especially important for taxa listed under Near Threatened, or Conservation Dependent, and for threatened species whose status is known or suspected to be deteriorating.

13. Transfer between categories

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

14. Problems of scale

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

III) Definitions

1. Population

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

2. Subpopulations

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

3. Mature individuals

The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Where the population is characterised by natural fluctuations the minimum number should be used.

- This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild.

- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (e.g. the estimated effective population size).

- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).

- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. Generation

Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

5. Continuing decline

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

6. Reduction

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

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7. **Extreme fluctuations**

Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e., a tenfold increase or decrease).

8. **Severely fragmented**

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

9. **Extent of occurrence**

Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g., large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

10. **Area of occupancy**

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

11. **Location**

Location defines a geographically or ecologically distinct area in which a single event (e.g. pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of a subpopulation of the taxon, and is typically a small proportion of the taxon's total distribution.

12. **Quantitative analysis**

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

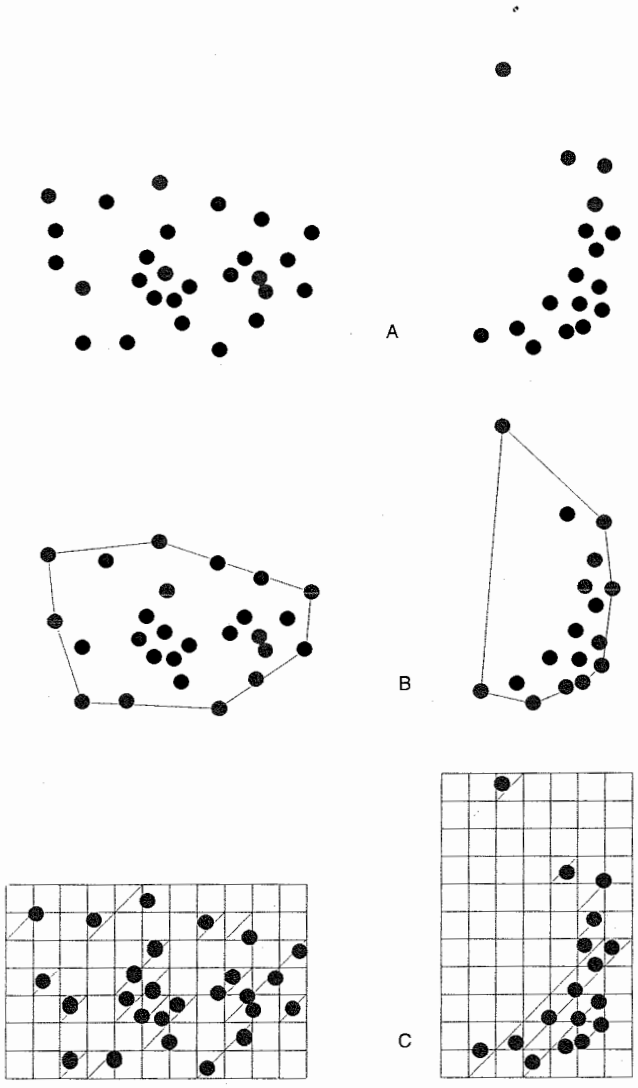

Figure 2:

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

IV) The categories [1]

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

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

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on pages 12 and 13.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on pages 14 and 15.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to D) on pages 16 and 17.

LOWER RISK (LR)
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk.

Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages.

Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

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

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V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

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

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

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

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

2) A reduction of at least 80%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 100 km^2 or area of occupancy estimated to be less than 10 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at only a single location.

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

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

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals.

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

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

2) A continuing decline, observed, projected, or inferred, in numbers of mature

individuals and population structure in the form of either:

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

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

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or 3 generations, whichever is the longer.

14

ENDANGERED (EN)

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

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

1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:

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

2) A reduction of at least 50%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000 km^2 or area of occupancy estimated to be less than 500 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than five locations.

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

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

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals.

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

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

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

a) severely fragmented (i.e. no subpopulation estimated to contain more than

250 mature individuals)
b) all individuals are in a single subpopulation.

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

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

VULNERABLE (VU)

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

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

1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer,, based on (and specifying) any of the following:

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

2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000 km^2 or area of occupancy estimated to be less than 2000 km^2, and estimates indicating any two of the following:

1) Severely fragmented or known to exist at no more than ten locations.

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

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

3) Extreme fluctuations in any of the following:

a) extent of occurrence
b) area of occupancy
c) number of locations or subpopulations
d) number of mature individuals.

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

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

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

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

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

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

2) Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km^2) or in the number of locations (typically less than 5). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

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

THE STATUS OF WILD CATTLE AND THEIR CONSERVATION IN VIETNAM

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INTRODUCTION

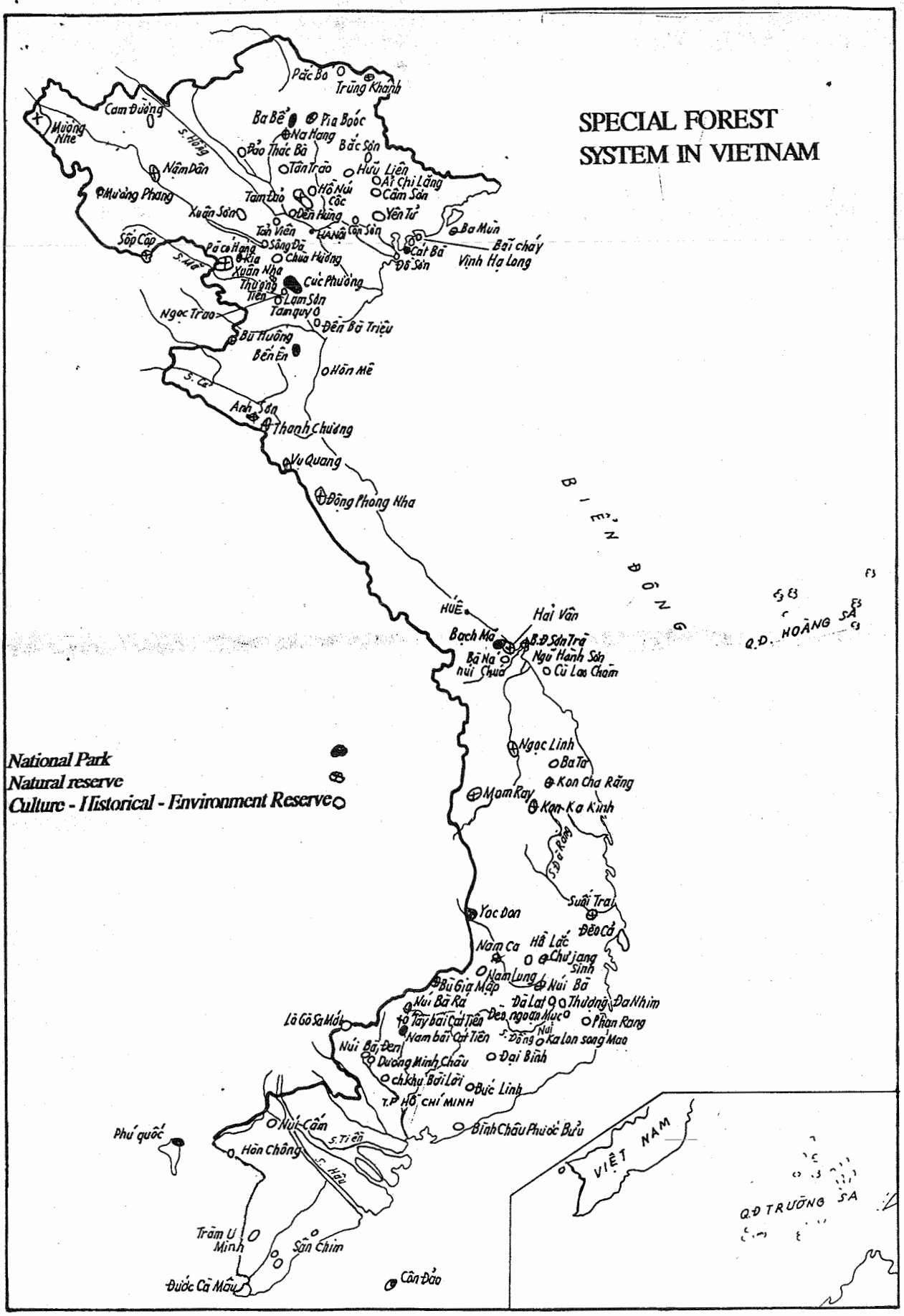
Vietnam is largely covered by mountains and is situated between latitudes 8N and 24N at the southeastern margin of the Indo - Chinese peninsula (Fig.1). The largest transversal of the country in the North is 530 km and the narrowest in the centre is only 43 km. To the north is China, to the west is Laos and Cambodia and to the east and south is the Pacific ocean. The coast line is about 3,200 km long. The surface area is about 332,540 sq. km. Vietnam is an agricultural country with human population of 65 million. Given the present rate of growth of 2.7% per annum, the average population density was 195 per sq.km in 1989 which is one of the highest for any agricultural country in the world, thereby placing an "impossible strain on the environmental capacity of the country" (IUCN, 1985).

FOREST COVER AND PROTECTED AREAS IN VIETNAM

Three - fourths of the country is covered by mountains. In the distant past the entire country was covered with dense tropical forest and the vegetation was predominantly of the monsoon evergreen type (Hoang Hoe & Vo Quy, 1990). But at the latter half of 20th century, especially since the Indo - China war, the country was heavily deforested. The total forest cover declined from 43.8% in 1943 (Maurand, 1943) to 23.6% in 1983 (Vo Quy, 1983). Therefore within 44 years, about 50% of the forest cover was lost, the average being 110,000 ha per year. Today the forest cover has declined to 21% (Vo Quy, 1987). According to Ministry of Forestry (1993) at the end of 1991 the total area of forest land is 19,065,700 ha which has 9,315,700 ha of forest (8,686,700 ha of natural forest and 629,000 ha of planted forest) and 9,750,000 ha without forest. The true extent of undisturbed primary forest however, may be only about 10% (Mackinnon, 1990).

The forest cover has declined very rapidly not only due to the long period of war (Kemf, 1986) but also due to rapidly expanding human population, logging of trees, setting forest fires for cultivable land and human settlements.

Hence, forest conservation, national parks and reserves are needed for the country. In 1962 the first National Park Cuc Phuong was established. Today there are ten National Parks (Cuc Phuong, Ba Be, Ba Vi, Cat Ba, Bach Ma, Yokdon, Nam Bai Cat tien, Con Dao, Phu Quoc, Ben En) and a total of 87 reserves, but only 49 National reserves have been included (Ministry of Forestry, 1993). (Fig. 1).


SPECIAL FOREST
SYSTEM IN VIETNAM
National Park
Natural reserve
Culture - Historical - Environment Reserve
Pắc Bó
Trùng Khánh
Cam Đường
Ba Bể
Pia Boóc
Mường Nhé
S. Hồng
Na Hang
Bắc Sơn
Pảo Thác Bà
Tân Trào
Hữu Liên
Nậm Dần
Hồ Núi Cốc
Ải Chi Lăng
Mường Phăng
Tam Đảo
Cấm Sơn
Xuân Sơn
Đền Hùng
Yên Tử
Tản Viên
HÀ NỘI
Cần Sơn
Ba Mùn
Sốp Cập
Pà cà Hang
Sông Đà
Cát Bà
Bãi cháy
Vịnh Hạ Long
S. Mã
Kìa
Chùa Hướng
Đồ Sơn
Xuân Nha
Thường
Cúc Phương
Tiến
Lam Sơn
Tamquy
Ngọc Trao
Đền Bà Triệu
Bù Hưởng
Bến Ên
Hòn Mê
S. Cả
Anh Sơn
Thanh Chương
Vụ Quang
Động Phong Nha
BIỂN ĐÔNG
HUẾ
Hải Vân
Bạch Mã
B.Đ Sơn Trà
Bà Nà
Ngũ Hành Sơn
núi Chúa
Cù Lao Chàm
Q.Đ. HOÀNG SA
Ngọc Linh
Ba Tơ
Kon Cha Răng
Mơm Rây
Kon Ka Kinh
S. Ba Rang
Suối Trai
Yac Đon
Đèo Cả
Nam Ca
Hà Lắc
Chư Jang Sinh
Nam Lung
Núi Bà
Bù Gia Mập
Núi Bà Rá
Đà Lạt
Thượng Đa Nhim
Đèo ngoạn Mục
Phan Rang
Tây bãi Cát Tiên
Là Gò Sa Mát
Nam bãi Cát Tiên
S. Đồng Nai
Ka Lon sông Mao
Núi Bà Đen
Dương Minh Châu
Đại Bình
ch.khu Bời Lời
Đức Linh
T.P HỒ CHÍ MINH
Bình Châu Phước Bửu
Phú quốc
Núi Cấm
S. Tiền
Hòn Chông
S. Hậu
VIỆT NAM
Q.Đ TRƯỜNG SA
Trăm U Minh
Sân Chim
Cần Đảo
Đước Cà Mau

DISTRIBUTION AND STATUS OF WILD CATTLE IN VIETNAM

Gaur (Bos gaurus)

The historical distribution of Gaur in Vietnam was largely in mountainous and forest areas. Today, the gaur populations are dispersed in the mountain areas from Laichau province in the north - west along the border of Vietnam and Laos, Truong son mountain range, Taynguyen plateau to Dongnai, Songbe, Tayninh provinces (Fig. 2).

The data on gaur distribution and number is got from field surveys and interviews with local people and hunters living in and around the gaur habitat. In 1976 - 1985, the number of gaur in Vietnam had been estimated to be about 5000 - 6500 individuals. In the last 10 years, number of gaur have declined by many times. In distribution areas the gaur population have broken up into small herds. The causes of the decline in number of gaur are due to forests destroyed the forest area narrowed, resulting in a loss of habitats for the gaur and other mammals too and by hunting.

Before 1985 in Laichau and Sonla provinces of the north - west there were about 450 - 600 gaurs (The Red Data Book of Vietnam, 1992). Today, it had been remained only about 150 individuals living in forest of Muongte, Muonglay, Muongnhe (Laichau province), Xuannha, Sopcon, Songma (Sonla province).

In Muong nhe's Nature Reserve of Laichau province (182,000 ha) in the early 1985 there are probably more than 150 gaurs. But now there are probably fewer than 35 and they appear to be restricted to four remote areas of Reserve (Fig. 3). Hence they are endangered, almost extinct (Cox & Giao, 1992). Pricipal threat is hunting.

The places where there are the most number of the gaur are the forest area of plateau Taynguyen. It was estimated that in the forest of three provinces: Kontum, Gialai and Daklak (Tay nguyen highland) there were about 3000 - 4000 gaurs before 1985. There was a gaur stock consisting of 40 - 50 individuals or more. In recent ten years, because of increases in forest exploitations and illegal hunting, the number of gaurs in Taynguyen highland has been decreased considerably. Almost gaurs live scatteredly in different forest areas and is estimated at about 1000 - 1500 individuals. They concentrate in the natural conservation areas such as Monray - Sathay district (Kontum province), Koncharang, Kon Ka Kinh (Gialai province), Yokdon National Park, Namca (Daklak proivince) (Table 1).

Banteng (Bos javanicus)

The historical distribution of banteng in Vietnam was largely in forest - mountainous areas of provinces belonging to the Taynguyen highland and the provinces such as Dongnai, Lamdong, Songbe, Tayninh, Khanhhoa, Baria. Before 1985, the banteng used to live in their stocks. Today the banteng has been seen in Sathay (Kontum province), Easup, Dakmin (Daklak prov.), Bugiamap (Songbe prov.), Baoloc (Lamdong prov.) and Suoitrai (Khanh hoa prov.) (Fig.4)

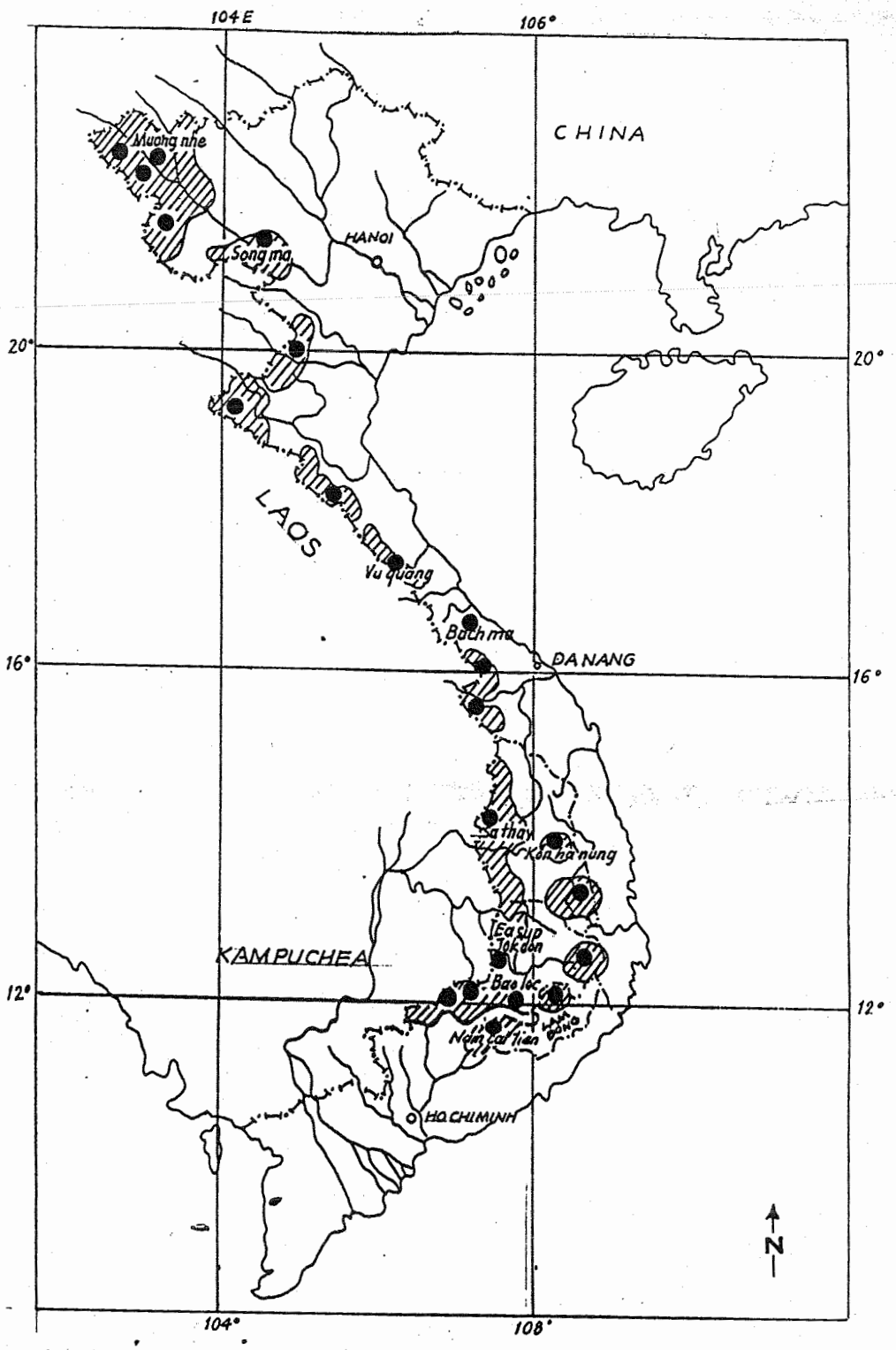


Fig.2. DISTRIBUTION OF GAUR IN VIETNAM (1990- 1994)

● Concentrated distribution area

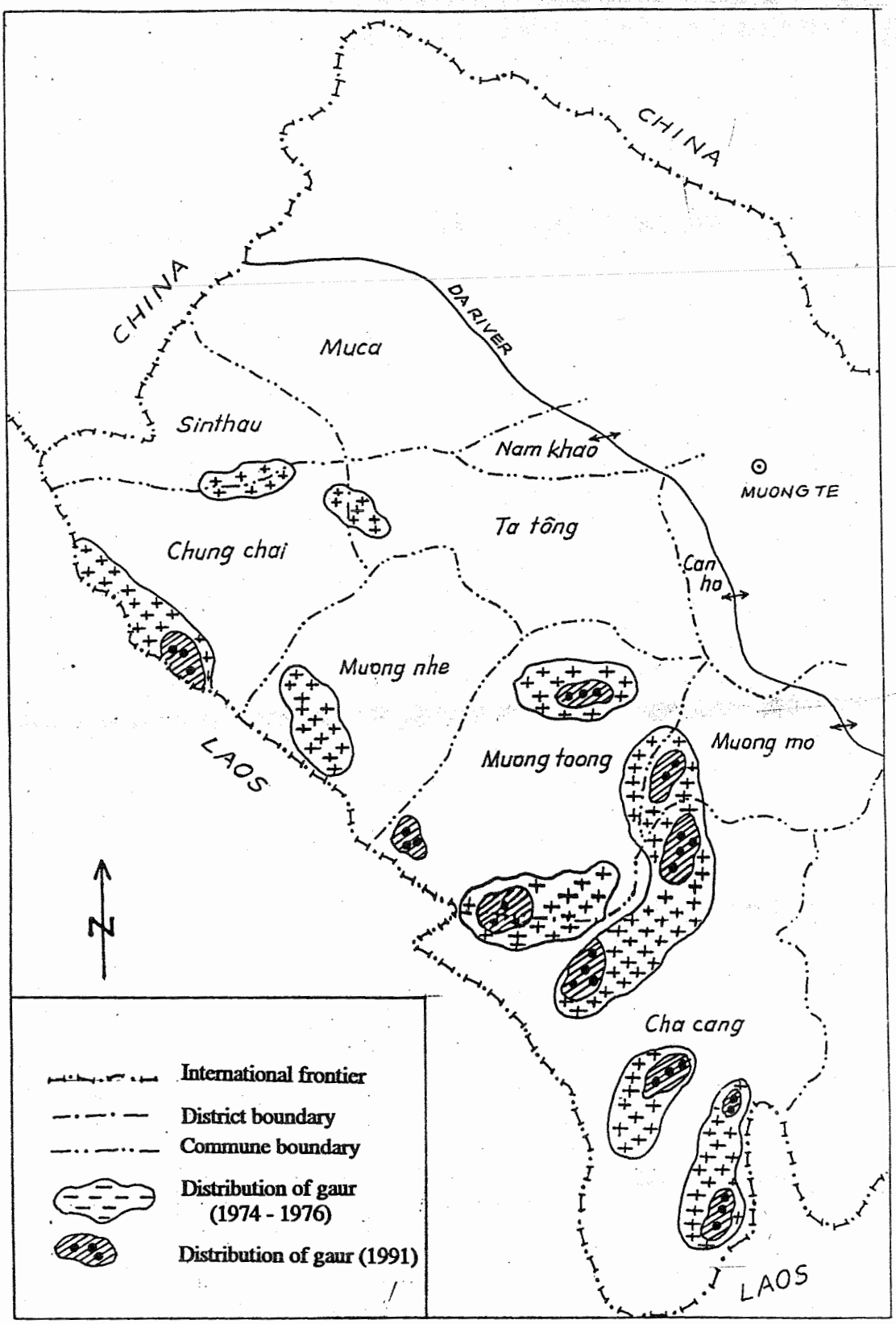


Fig.3. MAP OF MUONGNHE NATURE RESERVE SHOWING GAUR DISTRIBUTION

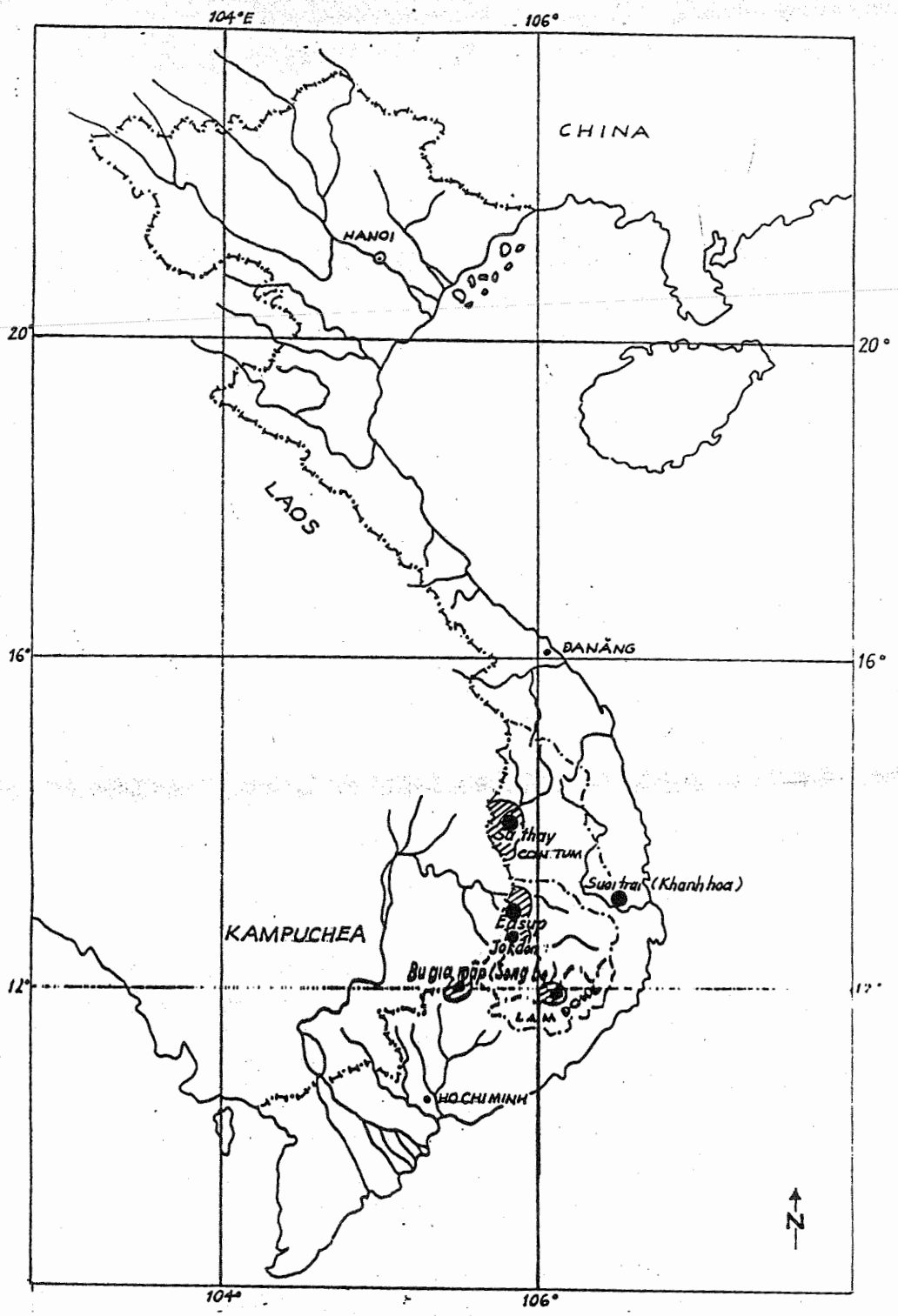


Fig.4. MAP SHOWING THE BANTENG DISTRIBUTION IN VIETNAM

● Concentrated distribution area

The data on banteng distribution and number is got field surveys and interviews with local people and hunters in and around the banteng habitat. In 1990 - 1993, the number of banteng in Vietnam had been estimated about 200 - 300 individuals. In recent years they have been hunted heavily and due to forest exploitation, so the number of banteng as well as many other mammal species have been decreased seriously. In Easup - Teoteo (Daklak province) where the banteng has been the most in Vietnam but today there are about 70 - 90 bantengs. In Yokdon National Park (Easup Daklak) some stock of banteng with 35 - 45 individuals has been still often seen (table 1).

INFORMATION ON KOUPREY (BOS SAUVELI) IN VIETNAM

After the investigating results of Urban A. (1937) who discovered Kouprey being in Cambodia. Scientists have confirmed that the Kouprey mainly distributes in Cambodia, the south of Laos, the South - east of Thailand and the south - west of Vietnam (Coolidge, 1974; Mackinnon and Stuart, 1989). In Vietnam, according to Monestrol (1952) the Kouprey distributed in forests of the Taynguyen highland but he had not specified where were the Kouprey's habitats and how many individuals they were.

From 1976 to 1985, Vietnamese zoologists had been carrying out their surveys in 30 sites belonging to mountain provinces, specially in three provinces: Kontum, Gialai and Daklak and obtained information about Kouprey and estimated that in forest areas near the border of Vietnam and Cambodia as well as Vietnam and Laos (The south of Laos) there were about 10 - 15 Kouprey (Vo Qui; Huynh D.H., 1983; Viet, T.H, 1986). Four areas where traces of the Kouprey had been found are as follows:

- Valley of Momrai mountain range in Sathay distrist, Kontum province.
- Teoteo - Easup distrist, Yokdon National Park, Daklak province.
- Quangxuyen area in Song Be province.
- Bugia map area in Song Be province (Fig.5)

Since 1991 up to now, information about the Kouprey obtained have been in relation to the Teoteo - Yokdon area. The local people said that in 1993 they saw 2 - 3 Koupreys in the forest area from Teoteo to Yokdon along the border of Vietnam and Cambodia and they have usually gone pass and returned through the border.

Therefore, the Kouprey may still remain existing in Vietnam but is has been being in threat of extinction.

Wild buffalo

Priously, in Vietnam the wild buffalo was already discovered in Thuathien - Hue province, the up stream of Dongnai and La nga rivers belonging to Dongnai province and Thudaumot of Songbe province.

In recent years, many investigations on mammals have not dicovered again the habitat of wild buffalo. During 1990 - 1993, although the horns of wild buffalo were found in the forest of Easup and Dakmin (Daklak province) but the local people have not seen the wild buffalo yet.

Thus, in Vietnam the wild buffalo might be already in extinction.

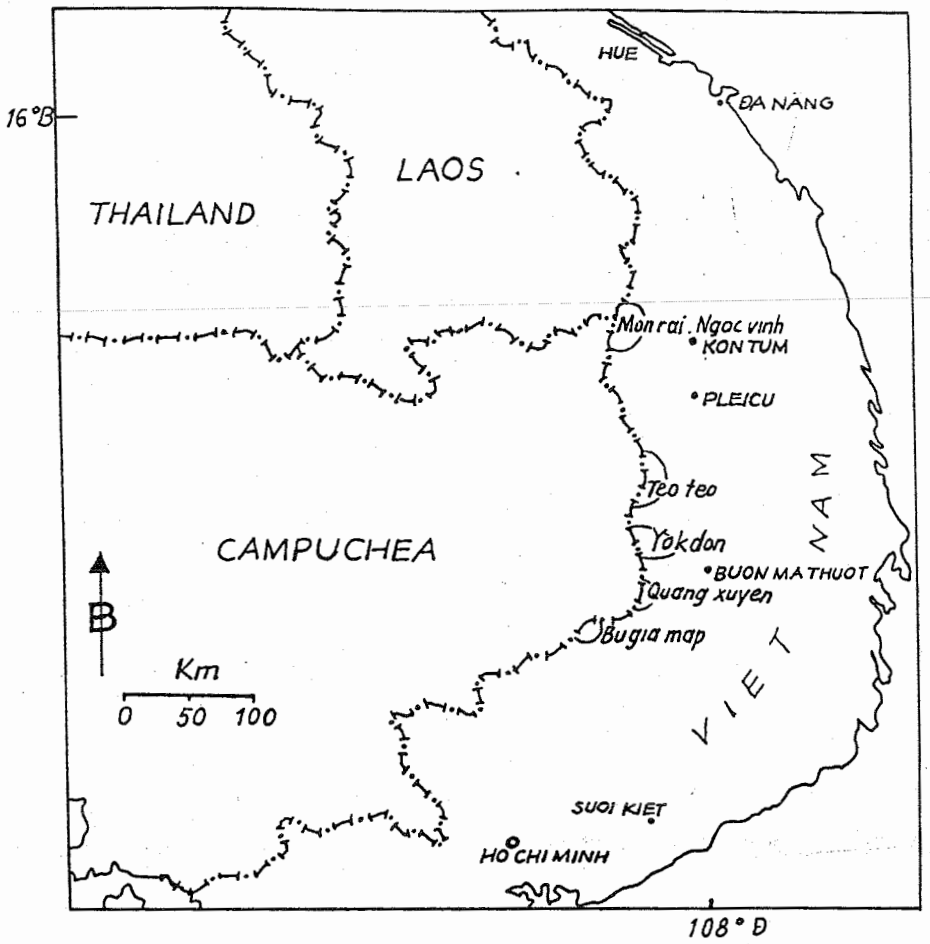


Fig.5. MAP OF SOUTHERN VIETNAM SHOWING AREAS WHERE TRACES OF KOUPREY HAD BEEN FOUND

CONSERVATION MEASURES FOR WILD CATTLE IN VIETNAM:

Vietnam goverment has implemented the law of Protection of Forest and Endangered Species to ban all four species: gaur, banteng, kouprey and wild buffalo are listed in the Red Data Book of Vietnam as endangered species. The following conservation measures for the gaur, banteng, kouprey and wild buffalo is proposed:

- There is a need to carry out field surveys on gaur, banteng, kouprey, wild buffalo distribution and number, especially in the reserves. Today the country has 19 out of 49 nature reserves with 756,000 ha forest and about 750 - 800 individuals of gaur, banteng (table 1). But many of the protected gaur, banteng reserves are too small to support their survival. Therefore there is a need to expand the buffer zones around these Protected Nature Reserves.

- The gaur, banteng, kouprey and wild buffalo are mainly distributed in the forest along the international frontiers between Vietnam, Laos and Cambodia. So one way of improving the survival protected of gaur banteng, kouprey population in Vietnam would be through the establishment of Trans - Frontier Reserves (TFR) adjoining Laos and Cambodia. Vietnam can establish nine TFR with Laos and three with Cambodia if the recommended extensions were to be carried out for Muong nhe (Laichau prov.), Sopcop (Sonla prov.), Buhuong (Thanhhoa prov.), Anhson, Truongduong (Nghean prov.), Vuquang (Hatinh prov.), Quangnam (Quangnam - Danang prov.), Momray (Kontum prov.), Yokdon (Daklak prov.) and Bugiamap (Songbe prov.)

References:

1. Cox, R., Giao, N.M. & Dung, v.v., 1992. Report of a management feasibility study of the Muongnhe nature reserve (November/ December, 1991). WWF & Ministry of Forestry, Hanoi, Vietnam.

2. Hoe, H. & Quy,V., 1990. Nature conservation in Vietnam. An Overview Regional Expert Consultation on Management of Protected Areas in the Asia Pacific Region. FAO Regional Office, Bangkok, Thailand. 10 - 14 December.

3. Hoffman, R.S., 1986. A new locality record for the Kouprey from Vietnam, and an archaeological record from China.Mammalia, 50: 391 - 395.

4. IUCN, 1985. Vietnam National Conservation Strategy (draft). Prepared by the Committee for Rational Utilisation of natural Resources and Environmental Protection (Program 50 - 02), with the assistance from IUCN.

5. Kemf, E, 1986. Seeds of recovery. In: Inside Asia, 9: 33 - 35.

6. Le Vu Khoi, 1988. Kouprey (Bos sauveli), the current state of knowledge, Mimeo. Paper presented at the

7. Laurie, A., Duc, H.D., Anh, P.T., 1989. Survey for Kouprey (Bos sauveli) in western Daklak province, Vietnam (draft). The Kouprey Conservation trust.

8. Lekagul, B. and Mc Neely, J.A., 1977. Mammals of Thailand. Assoc. conserv.. wildlife, Bangkok, 758 pp.

9. Mackinnon, J.R. and Stuart, S.N., 1989. The kouprey: an action plan for its conservation. IUCN. Gland, 19 pp.

10. Mackinnon, J., 1990. Review of the Natural Conservation System, National Parks and Protected Areas. FAO/UNDP, MOF Report No: 037. Hanoi, Vietnam.

11. Ministry of Forestry, 1991. 30 years construction and development of the Forestry, 1961 - 1990. Statistical Publishing House, Hanoi.

12. Pfeffer, P. and Ou Kin San, 1967. Le kouprey, Bos (bibos) sauveli.

13. Quy, V., 1987. Vietnam's ecological situation today. Keynote address at Lake Mohawk Ecology Conference New York State.

14. Quy, V., Huynh D.H., 1983. Zoological resources in Taynguyen highland. (Vietnam language).

15. Red Data Book of Vietnam, 1992.

16. Tran Hong Viet, Do Tuoc, Pham Ngoc Giao, 1988. Kouprey habitat in Vietnam. Mimeo. Paper presented at the International worshop on the Kouprey Conservation Programme, Hanoi, January, 1988.

17. Urbain, A., 1937. Le kouprey ou boeuf gris Cambodgien. Bull. Soc. Zool. de France, 62: 305 - 307.

TABLE 1: DISTRIBUTION AND NUMBER OF WILD CATTLE IN NATURAL RESERVES IN VIETNAM

Region - province	Name of Reserve	Area (ha)	Gaur	Banteng	Kouprey	Wild buffalo
North-West						
Laichau	Muongnhe	182.000	35(1993)			
Sonla	Soncop	5.000	17(1992)			
North of Annam						
Centre						
Thanhhoa	Buhuong	5.000	7(1993)			
Nghean	Anhson	1.500	5(1991)			
	Truongduong	7.000	7(1992)			
Hatinh	Vuquang	16.000	35(1994)			
Quangbinh	Buhuong	5.000	5(1992)			
Thuathien-Hue	Bachma	22.500	35(1993)			
Central highland						
Lamdong	Chuongdanhim	7.000	10(1990)	25(1990)	+	
Kontum	Momray	300.000	75(1992)			
Gialai	Koncharang	11.000	25(1994)			+
	Konkakinh	20.000	45(1994)	35(1993)	+	
Daklak	Yokdon	58.000	95(1993)			
	Quangxuyen	20.000	35(1993)			
Central coast of Southland						
Quangnam - Danang	Quangnam	12.500	20(1992)			
Khanhhoa	Suoitrai	19.000	25(1993)	7(1993)		
South- East of southland						
Songbe	Bugiamap	16.000	45(1992)			
	Tay bai cattien	10.000	15(1991)			
Dongnai	Nam cattien	36.000	55(1993)			

ONE THE WILD CATTLE IN CHINA

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There are three species of Wild cattle in China. They are Gaur(Bos gaurus), Gayal (Bos frontalis) and Wild yak(Bos grunnies). Their status and conservation in China are reported as follows:

1. Gaur(Bos gaurus)

(1). DISTRIBUTION:

Jiangcheng, Mengla, Simao, Jinghong, Menghai of southern Yunnan and Cangyuan of southwestern Yunnan and Yengjiang and Longcuan of western Yunnan province. Menyu, Luoyu and Xiachayu regions in Tibet.

(2). POPULATION STATUS:

There are certain amount Gaurs distributed at Xishuangbanna region in Yunnan. There are about 532 Gaurs according to investigation of 1983(331 at Mongla, 96 at Menghai, 91 at Jinghong and 14 at Simao). The population size increased lightly comparing with the result in 1970s(Yang Dehua et al., 1987). According to the current investigation the population size is about 700-800(about 600 at Xishuangbanna region, 50-80 at Simao and 30-50 at Cangyuan). Tibet

(3). ENDANGERED FACTORS:

①. The damage and deterioration of habitat made the habitat shrinked and disppeared(e.g. Jiangcheng of southern Yunnan); ②. The disterbance of armed conflicts of foreign races destroied the integrity of the range, isolated the continous distribution between foreign countries and China. The herd would not enter China(e. g. Rengjiang Gangbiguan Natural Reserve); ③. Illegal hunting made the population decrease and disappear. For example 33 Gaurs were hunted illegally at Xishuangbanna in 1979 and 39 Gaurs were hunted illegally from 1980-1983.

(4). CONSERVATION MEASUREMENTS:

Gaur has been listed as national I class animal protected ~~(National document [1989] No. 144, valid on January 14, 1989)~~. The natural reserves were set up at all main distributed areas(i.e. Xishuangbanna Nature Reserve, Nabanhe River Nature Reserve, Cangyuan Nangunhe River Nature Reserve, Yengjiang Tongbiguan Nature Reserve and Simao Caiyanghe Nature Reserve) in order to protect wild cattle. Most of the nature reserves were established in the period of 1980-1986. The total area is about

274,000has. After the establishment of the nature reserves the habitat of the wild cattle could be protected basically. In addition Illegal hunting has been stoped after the midist period in 1980s because of the strengthening of protection management and law enforcement, improvement of protection idea among the masses.

(5). CAPITIVITY STATUS:

There were 3-4 Gaurs raised off and on at Kunming Zoo. No one propagates.

2. Gayal, Mithan(Bos frontalis)

(1). DISTRIBUTION:

Gaoligongshan Mountainous Region of northwestern Yunnan province.

(2). POPULATION STATUS:

About 300-500 Gayals distribute at Gaoligongshan Mountainous Region.

(3). PROTECTION MEASUREMENT:

A Nature Reserve was set up in its distribution area.

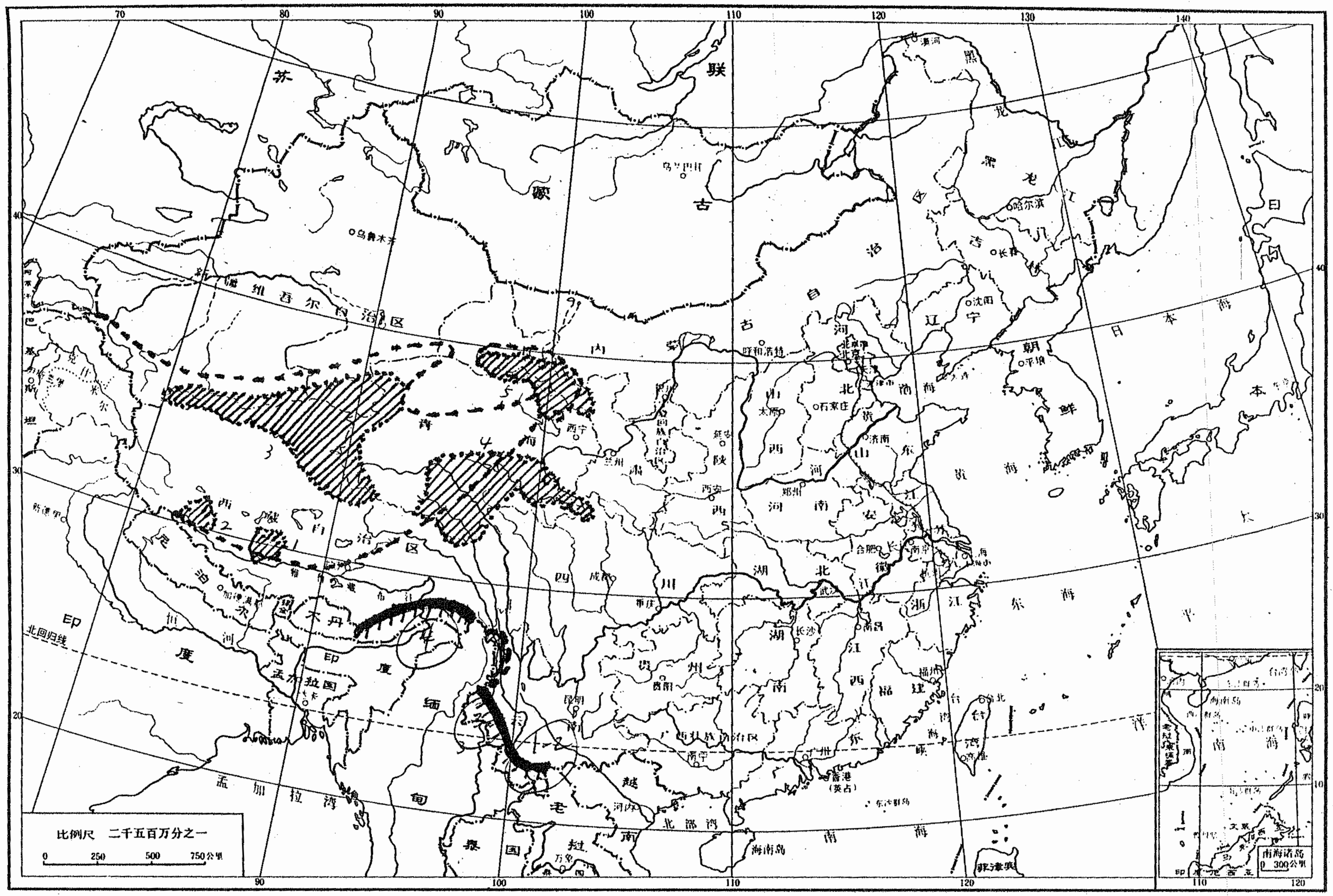
CITED LITERITURES:

Li Zhixiang, Yang Lan, Wang Yingxiang, Xian Rulun, Xu Qiming, Chen Weitang. 1986. The observation on growth and developement of Bos gaurus. Zoological Research. 1(3): 425-428.

Wang Yingxiang, Ma Shilai. 1987. The mammals and nature reserves in southwestern China. The proceeding of 1st international wildlife conservation conference. Tianlong film limited corperation in Hongkong. 330-339.

Yang Dehua, Zhang Cunjie. 1987. The quantitative distribution and conservation of rare and endengered mammals at Xishuangbanna. The collection of general investigation in Xishuangbanna Nature Reserve. In: Xu Yongcun et al., editors. Yunnan science and technology press. 311-319.

Yin Binggao et al.. 1993. Rear and endengered wildlife and their protection in Tibet. Beijing. China forestry press. 88-89.



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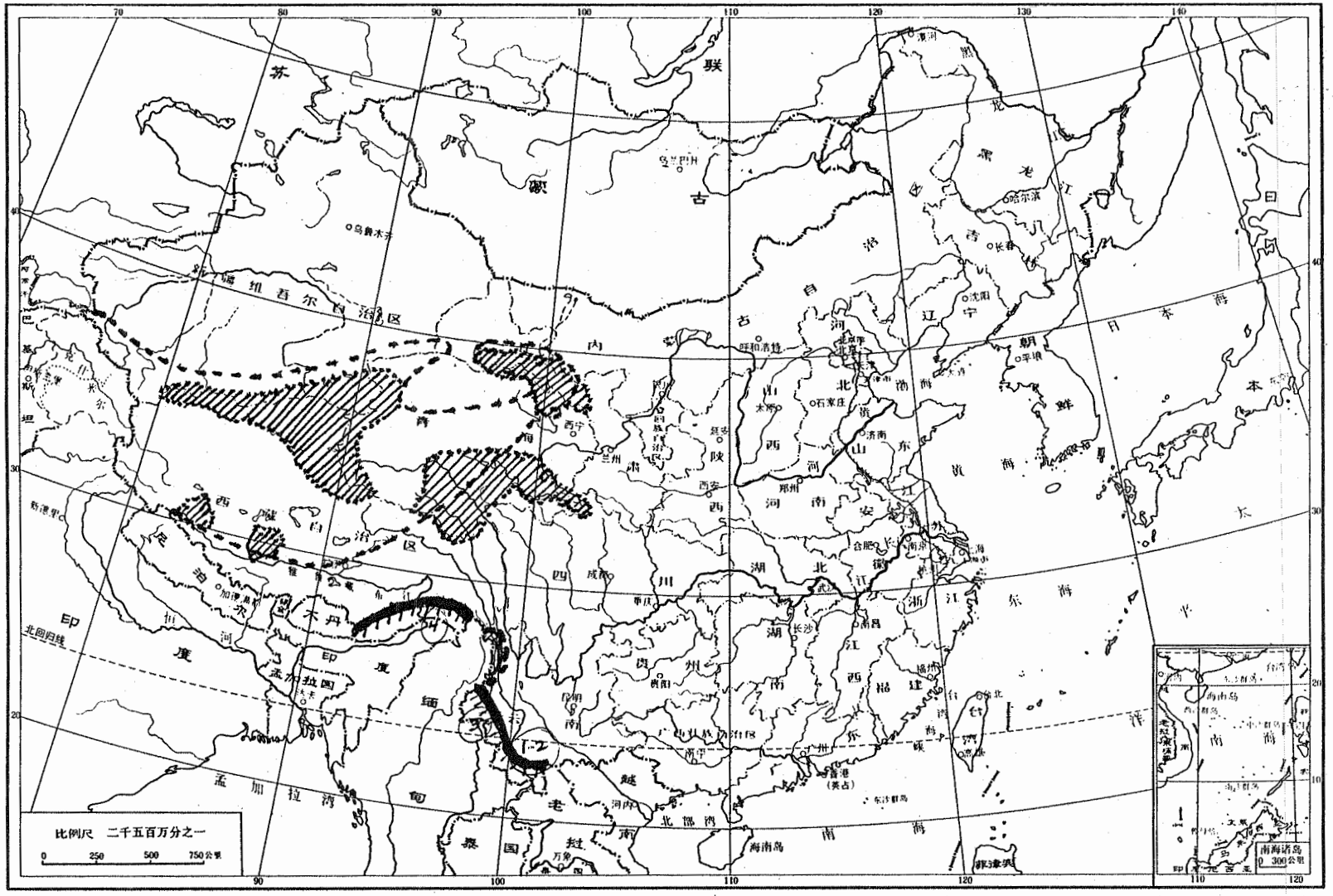
Distribution of Saur. B. g. 1-2 yaosiensis



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Current Situation of Wild Yak Population in China

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Summary

According to the survey data with 752km line transect sampling length and 267 detected wild yaks, the density and population size were estimated as 0.0791 yaks/km², 7959±802 individuals. Also there are 3031 yaks in Xinjiang, 130 yaks in Gansu, 5000 yaks in Qinghai, therefore total number is 16000—20000 yaks in China. Now the yak distribute in northwest Tibet and adjacent Aerjin and Qilain Mt., those habitats is about 200000km² in size. Now the yak number and distribution have decline drasticaly through various disturbs, uncotrolled hunting and development of livestocks by human being, so need to protect and adopt urgent measures to stop cutting trend of complete population.

The wild yak (*Poëphagus mutus*) is ancestor of domestic yak (*Bos grunniensis*). The wild yak has a gigantic body of strong physique. The head and body length is 2—3m, shoulder height is 1.3—2.0m, and weight is 500—1000kg. The large horns curve upward and forward in the males. Females have weaker horns. Long hairs that reach almost to the ground form a fringe around

the lower part of the shoulders, the side of the body, the flanks and thighs. The tail also has long hairs, and that forms a cluster. The general coloration is blackish brown, but sometimes with white spots in face.

The yak is a typical cold-resistant animal in high mountains. The yak only distributed in west and north of Tibet and adjacent highland of Aerjin and Qilian Mountains of China, also in Nepal, Bhutan and Sikkim.

In recent years the population size and density of the wild yak were investigated in all the provinces of yak distribution, even though that is with different precisions.

The authors has surveied the geographical distribution and population size of the wild yak in Tibet for 1987—1990. The survey results including other information of the yak from Xinjiang, Qinghai, Gansu and Sichuan provinces, were written in this paper.

Natural Environment

The Tibet plateau lies in southwest China, it is including large area from north Kunlun Mountains, toward to south the Himalayas; from west Kalakunlun Mountains toward to east to Hengduan Mountains. The size is as much as one-fourth of all China. The average elevation is over 4000m. The Tibet plateau is high and smooth terrain and it is nestling among the hills that is many snow mountains and magnificent laudscapes. so one may well say that this place is really the roof of the world. The yak

mainly distributes in mountains and plateau where is from Kunlun M. and to toward south and stride across the large Qiang Tang plateau get into the Gangdisi M. and Himalayas (Nepal, Bhutan, Sikkim), to toward northeast along the Aerjin M. and extend to the Qilian Mountains. So the extreme geographical coordinates are in 80—102°E. 29—40°N (Map 1).

There are many outflow rivers such as yangtze R., yellow R. Lanchangjing and Yaruzhangpu R., Shengezhangbu R. etc. and inland river and lakes such as Jiangaizhangbu, Zhajiazhangbu and lumajiangdongchuo, Zarinamuchuo etc. These water resources make and grow up large or small oasis in yourself surround, it provides food and water for wild yak and other ungulates.

The distribution area is highland. so the air layer is thin and deficient in oxygen. The climate is dry and cold, with -10℃ of annual average temperature and 50—300mm of annual precipitation, but the sunshine time is long and the sun—radiation is very strong, and its often blowing hard.

The wild yak habitat is in grass and desert highland and with elevation of 4000—5000m. There the soil is poor, the vegetation also composes very simple which are *Stipa purpurea*, *Arenaria musciformis*, *Carex moorcroftii*, *Ceratoides comparta and Parrva exscapa* etc. The high of the rows of plants is only about 5—10cm.

Survey Method and Calculate Formula

The population number of the yak is surveid with line tran-

sect sampling in Tibet for 1987—1990. In an area attempted to survey with known boundary and size A, the line L are transected (walked. flown. ridden on horse back) tracts and records detected objects n_i of target one, with every perpendicular distance x_i from the line to a detected objects. So any estimator of the density $\overline{D}$ of object in this line area is expressible as

$$\overline{D}=n/2La.$$

In particular, a is often referred to as one half of the effective strip width of the transect and its value is estimated from follow formula:

$$a=\int_0^w g(x)dx$$

In this equation w is the transect width or the maximum perpendicular distance at which observation are made, g(x) is the detection function. Obviously. $g(0)=1$. Let f(x) denote the probability density function of the perpendicular distance data. That probability function is related to g(x) as

$$f(x)=\frac{1}{a}\,g(x)$$

So $\int_0^w g(x)dx=\frac{1}{a}\int_0^w g(x)dx$

in particular, $f(0)=\frac{1}{a}\,g(0)=\frac{1}{a}$

Therefore, the density can be written in terms of f(0):

$$D=\frac{nf(0)}{2L}$$

In this survey, the author applied a Truncated Histogram Estimators as the detected function. Let $n_1, n_2, \cdots\cdots n_{k+1}$ denote de-

tected objects in the intervals $0<c_1<c_2<\cdots<c_{k+1}$, respectly. therefore

$$\bar{f}(0)=\sum_{i=1}^{k+1} a_i\left(\frac{m_i}{nc_i}\right)$$

Where $m_i=n_1+n_2+\cdots+n_i$, and

$$a_i=\frac{(-1)^{i-1}\left(\frac{1}{c_i}\right)^k}{\prod_{j=1}^{i-1}\left(\frac{1}{c_j}-\frac{1}{c_i}\right)\prod_{j=i+1}^{k+1}\left(\frac{1}{c_i}-\frac{1}{c_j}\right)}$$

Where terms such as $\prod_{j=1}^{0}$ and $\prod_{j=k+2}^{k+1}$ are defined to be 1. In thise method, subjective decisions to specify k and $c_1, c_2, \cdots, c_{k+1}$, and the estimator can depend critically upon those choices.

Distribution Region

In former times, the wild yak is wide-rangingly distributed in most parts of Tibet Plateau and adjacent mountains which belongs to ~~Tibet~~ Xinjiang, Qinghai, Sichuan and Gansu province in administrative divisions. But now, according to survey of 1987-1990, the wild yak has been disappeared from Chinese side of Himelayas, and it retained only in Nepal, Bhutan and Sikkim of this Mountains. In the Gangdishi Mt. valley may also be disappeared.

Fortunately, it is still remained two small distribution region of north slope. One of them is in Cuomai-Chazi of northern Angren County, may be including adjacent extreme northeast region of Cuoqin county (Map 1a), another region is in Maila - Xiangzhu of Zhongba county (Map 1b). The two distribution area is about more

S = 13600 km²
N = 314

S = 12300 km²
N = 909

10 000km² in size,separately. More seriously, a large area is appeared blank space of the yak in plateau between Kunlun and Gangdishi Mountains.

There is a broad distribution region in highland Kunlun and Kekexili Mountains with about 80,000km² in size (Map 1C).

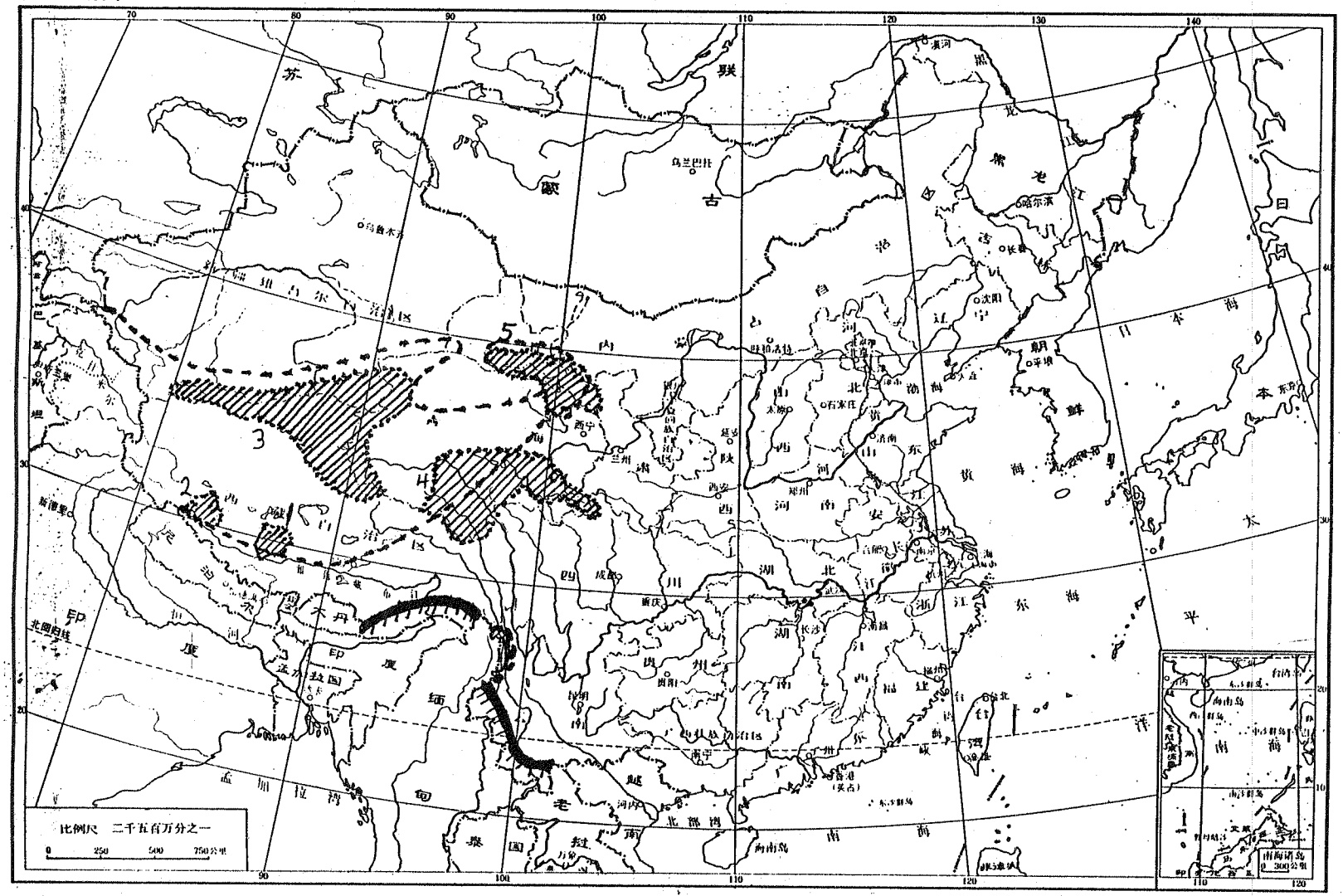
In Aerjin Mountains of Xinjiang province, the yak is concentrated in Kumukule Basin and surronding mountains their extreme boundary is arrived in Qiemo and Ruoqiang county. But now, it may be already disappeared former large distribution region in Hetian and Kashi Prefecture. Perhaps a small flock of the yak has still retained in source area of Keliya River (Liang Chongqi 1984), but it also raised doubts of its exist now.

In Qinghai province, the yak is widely distributed in Kekexili, Bayankala, Animaqing Mountains and enter to the boundary (Maqu County) of Gansu province, and from it to toward north stride across the Ela, Qinghainan Mountains and joins the Qilian Mt. region. The Qilian region is only confined in a few area of Qilian, Sunan. Subei and Akesai counties (Zhengshengwu et al, 1994) (Map 1C). But some reports believed that the yak has been disappeared from nearby region of Qinghai lake (Ye Xiaoti 1993). From that it maybe indicates that the Qilianshan region is cut off from Kunlun Mountains regions. If it is true, we feel great anxiety about the future and destiny of this region. Another potential notice is that with opening and developing the Qingzhang road, the yak can perhaps be disappeared from two side along the road line, and then cut completely off

Table 1: The distribution and number of wild yak in China

	County or Region	Place	S (km^2)	N
1	Aunren	Cuo mai, Chazi	15617	314±80
2	Zhongba	Maila, Xiangzhu	12368	809±161
3	Kunlun Mt.	Kekexili	75229	(6836±561)
	Aerjin Mt.	Kumukule	2000	
	Kunlun Mt.	Keliya	45000	→ 10000
4	Kunlun Mt.	Bayankala	4000	3000-3500
5	Qilian Mt.	Subei, Sunan	2000	1500-2000
			156000Km²	16000-20000

地理底图



from Kekexili regions. This potential dangerous is already appeared, the proper authorities, specially protection unit must adopt urgent measures to stop this trend and protect it to joins between two distribution regions. In Sichuan province the yak was found in along while in Shiqu county of northern Sichuan (Hu Jinchu 1984). But according to survey of 1993, it can't meet any individual yak and its trace (Wang Youzhi 1993).

Distribution Density and Population size

According to the survey of 1987—1990, the average density is about 0. 0791 individuals/km^2. and the maximum is arried in 0. 2307 indi. /km^2, the minimum is to 0.0086 indi. /km^2 in Tibet. The population size is estimated as 7959±802 yaks with habitat area of 100, 000km^2, 6800 yaks of them distributed in Kekexili mountains of Tibet; 800 yaks is in Zhongba region and 200 yaks is in Angren region (Table 1).

In Xinjiang province, the yak density is about 0. 067 indi. / km^2, it's similarity to Tibetan density, and there are 3031 or 10 000 yaks in Kumukule nature reserve with 4, 500 km^2 in size (Gujinghe 1987).

In Gansu province, the yak population number is estimated as about 130 individuals(Wang Xiang ting 1990).

In Qinghai province. there is no data of population number. If we can estimate the population size of the yak, refering to adjacent Tibetan density, it is about 4500—5000 yaks in 60000km^{2}of its habitats.

Table 1. The survey data and calculated densities and population numbers in Tibet for 1987—1990

County	Place	date	L (km)	X (km)	n (head)	$\bar{D} \pm t\sqrt{Var\bar{D}}$ (head/km²)	S (km²)	N (head)
Gaize	Chabe	9/x	58	2	7	0.0086±0.0026	28834	248±75
				4	12			
Ritu	Xianqie l.	13/1x	203	1	12	0.0510±0.0026	19640	1002±51
	Huilong	12/1x	37	2	10			
				4	23			
				6	136			
Zhongba	Maila	7/v11	43	2	7	0.0654±0.013	12368	809±161
				4	5			
Angren	Chazi	22/v11	56	1	4	0.0201±0.0052	9000	181±47
	Cuomai	21/v11	128	2	2			
Shuanghu	Chashang	3/v111	140	1	20	0.2307±0.018	20138	4646±362
	W.N	31/v11	55	3	8			
	W	29/v11	32	6	21			
Anduo						0.2307±0.018	4076	940±73
Cuoqin						0.0201±0.005	6617	133±33
Σ			752		267	0.0791	100673	7959±802

So that, the wild yak population size is about 16000 individuals or less than 20000 yaks in China.

And according to detected 267 yaks, dividing 21 flocks in this surey of Tibet, the average number of a flock is calculated as 12.71 yaks, while the average males flock is 3.423 yaks, and 90.30 yaks/ flock in females and youngs in Xinjiang Kumukule. (GuJing-he, 1987).

The reasons of population decline

The reasons lead to decline population size is mainly as follows

1. Human disturb: Even though, the yak is almost not afraid of human and human also is not directly destroied the yak habitats, but the yak is highly sensitive to any human disturbs, such as building, livestock farming, and constructing road etc., specially to the latter and motors roared. So that the Qingzhang, Xinzhang, Naa (Anshi) and Lapu Road maybe become a main reason for cutting the complete habitat to the several solitary regions.

2. Uncontrolled hunting by human From olden days, local people has hunting the yaks for food and other daily necessities. Now the protecting yak polity has already implement since the 1980's, but the harvest yield of hunting yak is still very high.

In Xingjiang, Sichuan and Gansu province. it often take place serious encircl hunting yaks for the 1960's. Obviously, uncontrolled hunting by human is derect reason for decline yak population in all distribution regions.

3. Invade and occupy territory by livestock

Even though the yak habitat in highland of 4000—5000m of the elevation, but it often go down to grassland and grassy marshland for fooding. But presently, development of livestocks[1] is continuously invaded and occupied grassland which make good use of fooding by the yak for seasonly or all the years. So that the yak has losed may good fooding districts. This is just a reason for appearing blank space of yak in Qiangtang plateau and other places.

4. Harsh climate and diseases Of harsh climate, the deep snow is seriously effect yak fooding behavior, and then the hunger yak easy infect many deseases, and cause death in a large number.

References

王酉之.四川石渠兽类1959年与1983年比较调查人类活动影响下兽类的演变.夏武平、张洁主编.1994.P155—158

尹秉高、刘务林.西藏珍稀野生动物与保护.中国林业出版社.北京.1993.15—19;81—91.

马鸣、谷景和、冯祚建.和田、喀什、克孜勒苏三地川山地动物高源及其分布.干旱区研究.1990.第1期.53—58.

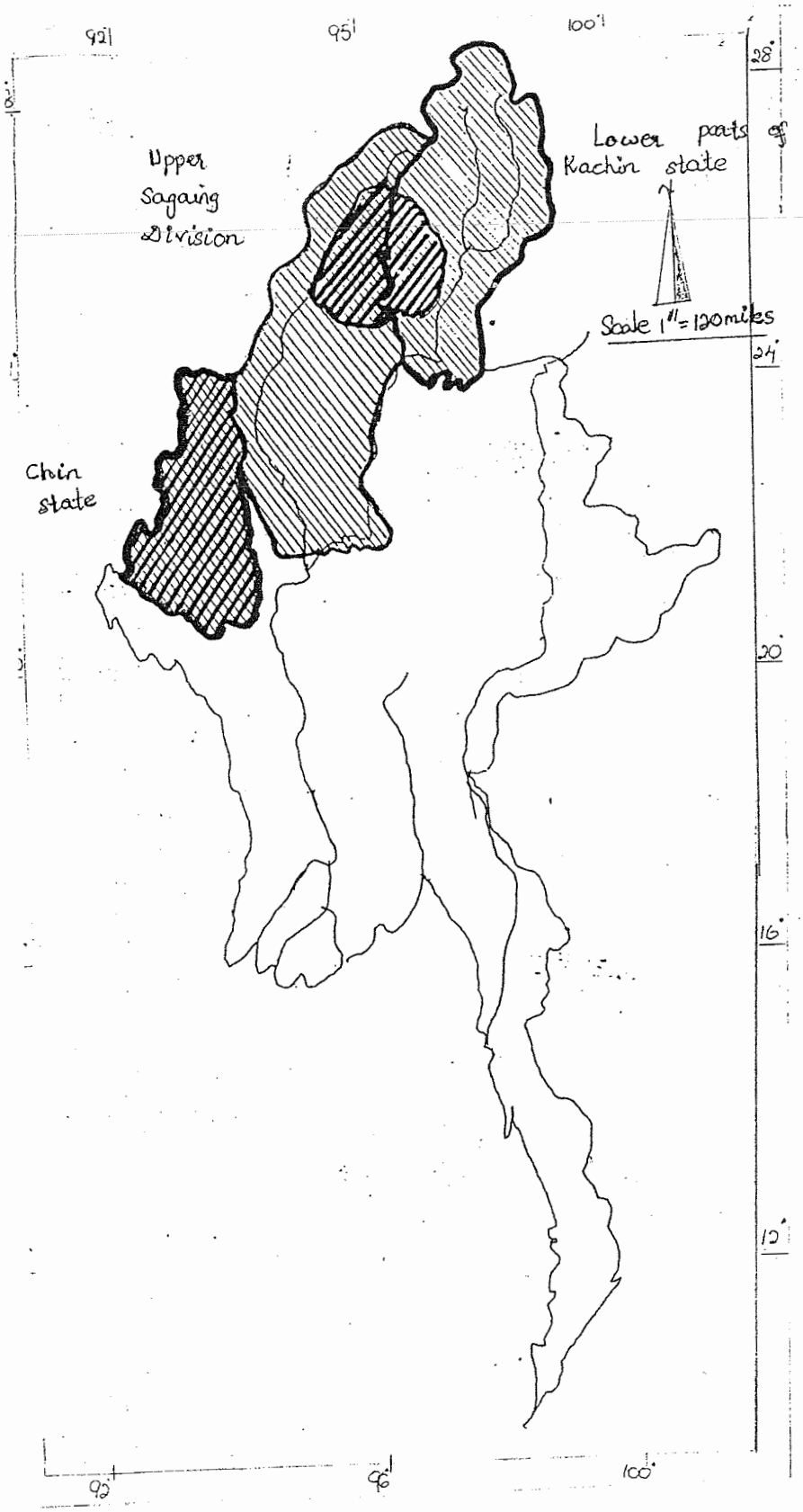
叶晓堤.1994.青海湖地区鸟兽组成特征及生态动物地理群的研究.中国动物学会成立60周年纪念论文集.中国科技出版社.1994.北京.P361—369.

[1] Domestic yak number is 4192300 heads, yak ×cattle is 294700 heads in Tibet (1992).

Maps of Wild Cattle Distribution in Myanmar

by

Khin Than Win and Su Su Oung



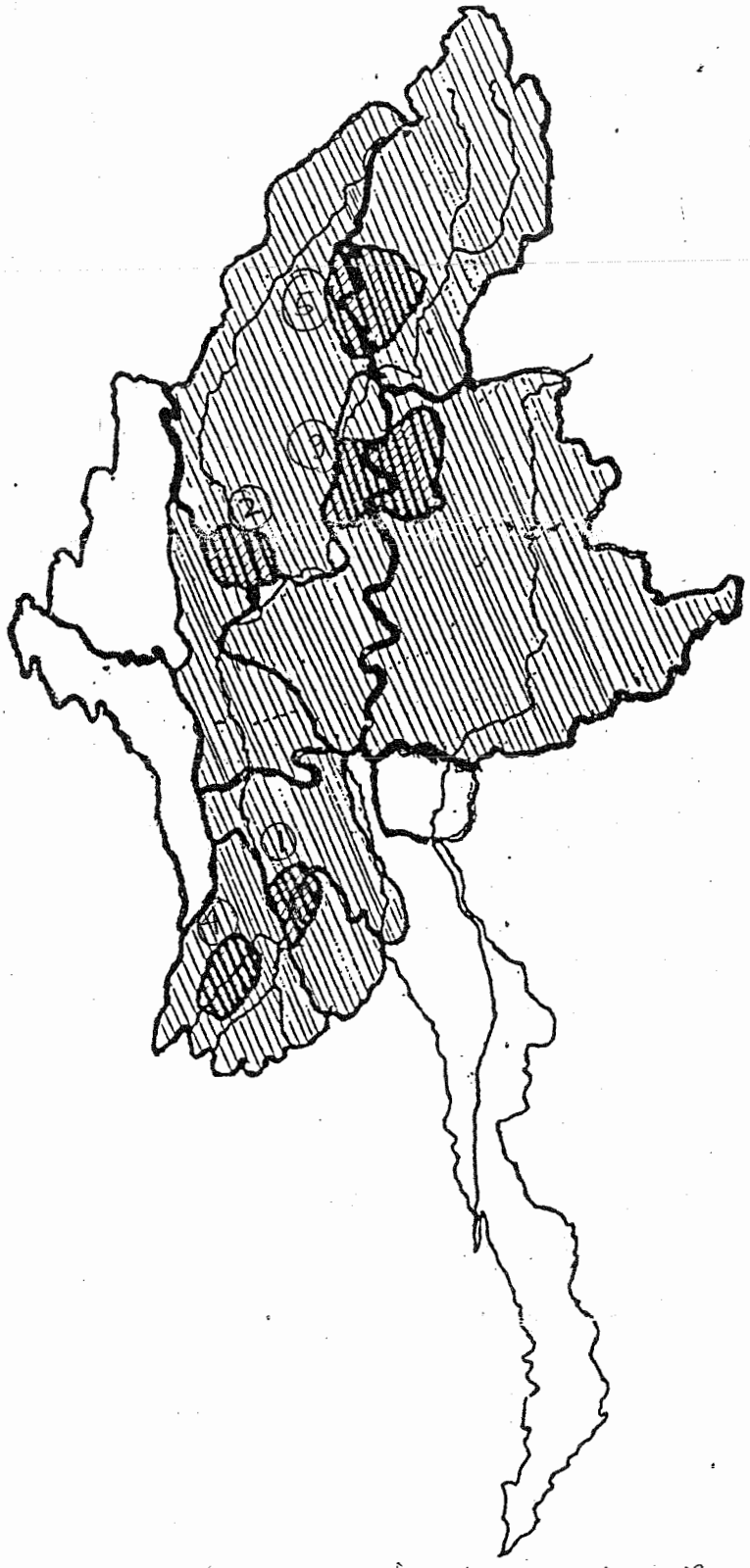
1.7 km = 1 mi

5" × 14

1" = 204 Km

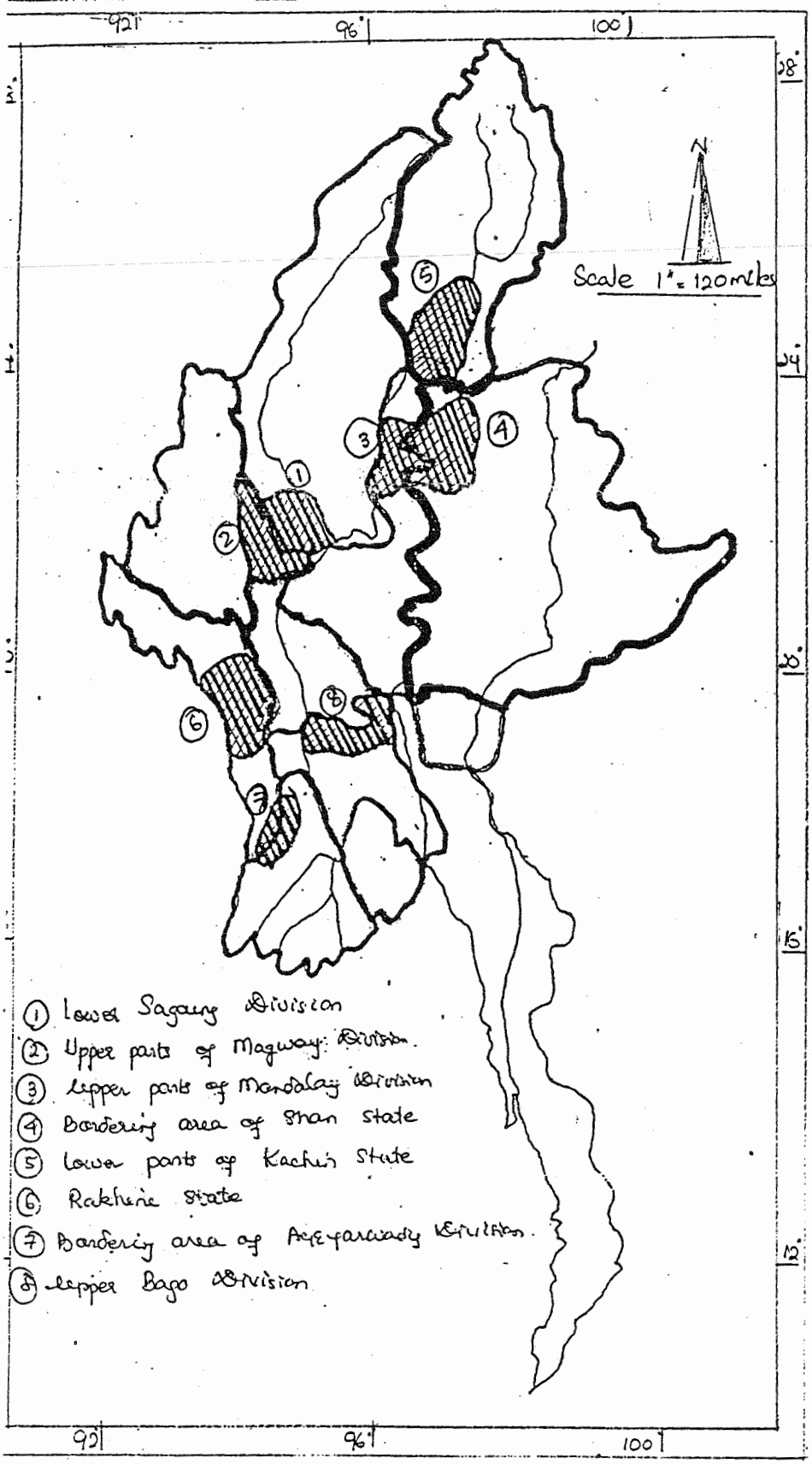
Distribution of Mythun in Myanmar.

(Bos frontalis)



Distribution of banteng in Myanmar

(1) bandering area of Bago Division
(2) Lower Sagaing Division
(3) bandering area of Mandalay Division and upper parts of Shan state
(4) Ayeyarwady Division



Gaur.

Distribution of Gaur in Myanmar

Henry Doorly Zoo
Gaur Research Program Summary
1994-1995

by
Douglas Armstrong, DVM
Dan Cassidy
Naida Loskutoff, PhD and
Lee G. Simmons, DVM

08/09/95

Genome Resource Bank

Semen -

The current total semen inventory for gaur at Omaha is 14,021 straws and 90 vials of semen from 45 bulls. An additional 1,380 straws from 14 of these bulls are banked with Steve Hopkins, DVM at Iowa State University.

Embryos -

The current embryo inventory for gaur is:

Henry Doorly Zoo - 8 embryos from two dams and one sire.
TransOva Genetics - 12 embryos from four dams and one sire.
Rafter D Genetics - 11 embryos from two dams and one sire.

Details of specific dams and sires are on the attached inventory.

Semen Banking -

Emphasis during this time was placed on reevaluating semen quality for each bull using percoll gradients and an accurate reinventory of banked semen. Multiple person access to the bank and resistance to using the record system resulted in some inaccurate inventory numbers. This reinforces the need for restricted access and accurate record keeping for genome resource banks.

The following gaur bulls were electroejaculated and the semen cryobanked in 1995.

Omaha ISIS	Studbook No.	Straws Banked
3604	195	166
4865	336	162
5811	575	158

As indicated on the attached inventory, semen quality based on percoll gradient evaluation varies a great deal. Our goal in freezing is 10 million motile live sperm per straw at post-thaw. The reinventory of straws is still underway so total numbers may vary from the attached lists.

Artificial Insemination with Charles Looney, PhD - TransOva Genetics.

Gaur cows were artificially inseminated on August 17 and August 18, 1994 at 72 and 96 hours post prostaglandin (Lutalyse) treatment.

Protocol:	Day 1	Dinoprost tromethamine (Lutalyse) IM (25 mg)
	Day 11	Dinoprost tromethamine IM (25 mg)
	Day 14	Artificial insemination
	Day 15	Artificial insemination

The semen used was high concentration live motile sperm achieved by performing percoll gradient separations on multiple straws of each bulls semen. Although 3 of the 4 gaur responded to the prostaglandin treatment, none of the animals were diagnosed pregnant by ultrasound on 30-09-94, although two were suspicious. All gaur were rechecked for pregnancy on 23-02-95 and none were found to be pregnant by rectal palpation.

One aspect of this trial that was weak was that the AI's were timed according to prostaglandin injections rather than observations of heat behavior in the cows.

In Vitro Fertilization with Brad Lyndsay - University of Nebraska and Charles Looney, PhD - TransOva Genetics

Transvaginal ultrasound guided oocyte collections were performed on six gaur cows on June 2, 1995. The cows were prepared with the following protocol.

Day 1 - Placed 6 mg norgestamet implant (Synchro-Mate B) subcutaneously in ear and hand injected with 3 mg norgestamet and 5 mg estradiol valerate.

Day 7 - Injected with 75 IU of follicle stimulating hormone (Super OV) in carboxy methyl cellulose intramuscularly.

Day 10 - Transvaginal ultrasound guided oocyte collection.

Results

Omaha ISIS	Studbook	Oocytes Collected	No. Cleaved	Oocytes Banked	Bull Studbook #
5429	669	13	7	2	239
5443	671	20	14	6	378
5444	672	27	18	2	378
5539	501	45	18	2	378
5540	502	12	9	2	378
5681	678	18	9	1	239

Frozen IVF Embryo Transfer Project with Brad Lyndsay - University of Nebraska and TransOva Genetics

Three of the IVF embryos from the genome resource bank were transferred to gaur cows at the Henry Doorly Zoo in late August 1995. The reproductive cycles of the cows were manipulated for these transfers with the following protocol.

Day 1 - 10% progesterone intravaginal implant devices (CIDR) were placed in 5 cows.

Day 6 - 750 mg cloprostenol sodium (Estru-mate) intramuscular.

Day 7 - CIDR devices removed.

Day 8 - Dawn and dusk observations for heat behavior.

Day 9 - Observations for heat behavior at dawn and dusk. Rectal palpation and ultrasound evaluation of ovarian structures. Two cows were given 100 mcg of human chorionic gonadotropin intravenously to induce ovulation.

Day 10 - Cows observed for heat behavior at dawn and dusk.

Day 16 - Transfer of frozen IVF embryos. Transfers were done as follows on August 25, 1995.

Recipient Omaha ISIS & Studbook	Dam Studbook	Bull Studbook
5443 (671)	669	239
5444 (672)	671	378
5681 (678)	669	239

Cows will be checked for pregnancy on or about October 1, 1995.

Superovulation, Artificial Insemination and Embryo Collection with Clifford Dorn, PhD - Rafter D Genetics.

Three gaur cows have been extensively chute trained and utilized for superovulation and embryo collection trials. To date there have been 14 individual attempts on 6 different dates. Eleven embryos have been produced by artificial insemination using frozen semen and are currently banked at Rafter D Genetics.

Dam ISIS & Studbook	Sire Studbook	# of Embryos
4901 (351)	336	7
4758 (330)	336	4

Response to stimulation has worked well, however poor semen quality has resulted in poor embryo production. Although bull 336 is genetically valuable the low quality of semen has required multiple straws of semen to be used for each AI after concentration using percoll gradients.

Inter Species Embryo Transfer with TransOva Genetics

A second gaur calf produced by in vitro fertilization and transferred into a domestic cow recipient was born on 21/04/95. The first recipient cow in 1993 was a holstein and the calf was delivered by caesarean section. The second recipient was a black white faced beef heifer who delivered naturally after a gestation of **324** days from the date of transfer of a 7 day old IVF embryo. The embryo had never been frozen.

Delivery was uneventful but the calf appeared weak after birth. Routine neonatal management was applied including colostrum, vitamins and vaccinations at about 12 hours after birth. The calf was continually observed for the first 24 hours and did not nurse the dam in spite of good maternal attention. Blood work from 12 hours of age reflected most notably hypoglycemia and anemia with marked microcytes, poikilocytes and schistocytes. Appropriate medical care was applied including intravenous dextrose, whole blood transfusions, antibiotics and hand rearing using established techniques.

Initially the calf improved and got stronger over 72 hours but then declined and died at 4 days of age. On necropsy the primary cause of death was determined to be an E. coli meningitis.

The recipient domestic cow that delivered the gaur calf was found to have antibodies to gaur red blood cells. This may have been significant for the calf in relation to the initial and progressive anemia, disease susceptibility and poor condition of the calf.

Genetic Mapping of Domestic Cattle with Texas A & M University.

Three gaur/domestic cattle hybrids produced from semen provided by the Henry Doorly Zoo are currently being utilized to produce embryos for a gene mapping project of domestic cattle.

Current Plans

Continue superovulation, artificial insemination and embryo collection at Rafter D Genetics. Higher quality semen needs to be provided.

Continue transvaginal oocyte collections and IVF at Omaha with TransOva.

Continue semen collection and banking.

Consider further interspecies embryo transfers into domestic cattle and gaur/cattle hybrids to study possible immunologic compromise and compatibility problems.

Consider transfers to Brahma cattle.

Consider further artificial inseminations or embryo transfers to gaur if sufficient cows are available.

Consider transfer of male gaur calf (Omaha ISIS 8542) born July 21, 1995 to Rafter D Genetics for hand training to chute for collection of semen without immobilization. Calf sire is 3604 (195) and dam is 7317 (278).

GAUR FROZEN SEMEN INVENTORY SUMMARY
Current 12-09-95

Studbook #	No. of Straws at Omaha	No. of Straws at Other Locations	Dates
130	60		07-06-88
162	286	130	24-01-89 to 27-11-91
192	120		29-09-87
195	641		03-02-93 to 15-06-95
203	335	170	19-09-87 to 14-11-90
219	105	40	02-01-89
234	353		27-10-88 to 02-03-89
239	467	150	21-09-89 to 16-02-90
255	450		25-10-93 to 15-12-93
282	140		04-11-93 to 03-12-93
284	40	20	12-10-89
285	110	20	06-06-88 to 27-07-89
286	110	50	02-10-88
289	70		17-01-92 to 25-02-92
293	170	80	19-01-89
327	220	130	03-11-88 to 01-06-89
332	515	200	17-04-90 to 06-06-91
336	792	150	01-12-88 to 26-06-95
352	760		20-01-92 to 28-01-93
370	410		04-11-93 to 03-12-93
377	515	200	20-04-89 to 19-11-91
378	215	40	14-09-89 to 25-08-94
380	290		11-06-92
384	640		16-11-93 to 14-12-93
385	800		28-10-93 to 01-10-94
388	545		27-10-93 to 13-12-93
389	730		18-11-93 to 01-10-94
409	126		21-03-93
425	277		03-11-93 to 02-12-93
436	90 vials		11-12-92
441	396		28-02-93 to 22-03-93
455	510		26-10-93 to 14-12-93
469	84		28-02-93 to 21-03-93
473	20		04-03-93
480	180		27-10-93 to 15-11-93
531	78		02-03-93 to 02-04-93
533	69		03-03-93 to 02-04-93
534	44		25-03-93
575	468		18-10-93 to 28-06-95
T9170	350		18-03-94 to 04-11-94
T9188	410		03-11-93 to 02-12-93
T9189	190		03-11-93 to 02-12-93
T9209	330		18-03-94 to 03-11-94
T9221	260		18-03-94 to 03-11-94
T93004	340		18-03-94 to 05-11-94

Number of Bulls	Number of straws at Omaha	Number of straws at Other Locations
45	14021 + 90 vials	1,380

HENRY DOORLY ZOO
GAUR FROZEN SEMEN INVENTORY
Current 12-09-95

Studbook #	Collection Location	ISIS #	Freezing Date	# of Straws	Post Thaw % Motile	Post Thaw PFM (0-5)	Post Thaw % Intact Acrosomes	Percoll Actual Million Motile per Straw	Dispersal Date	Dispersal #	Dispersal Use
130	HDZ	3243	07-06-88	60	0	0	77	0	18-11-93	2	PER
162	HDZ	5138	24-01-89	65	0-60	0-4	83	8.5	18-11-93	2	PER
162	HDZ	5138	26-09-91	150	10-60	2-3	83	5	18-11-93	6	IVF
162	HDZ	5138	27-11-91	71	30	2	79	3.5	18-11-93	2	PER
192	HDZ	3520	29-09-87	120	10-50	3	85	2.5	18-11-93	4	IVF
203	HDZ	4143	19-09-87	50	30	3	68	3	19-11-93	2	PER
									05-08-93	2	LAJ
203	HDZ	4143	08-11-89	240	10-40	3-4	65	2.5	18-11-93	4	IVF
									05-08-93	2	LAJ
284	HDZ	4251	12-10-89	40	30	3-4	73				
219	HDZ	5551	02-12-89	105	10-50	2-3	73	6.25	18-11-93	4	IVF
336	HDZ	4865	27-02-92	137	20-50	3	75	11.25	19-11-93	5	PER
336	HDZ	4865	25-06-92	270	30-60	2-4	77	6.75	19-11-93	5	PER
336	HDZ	4865	01-12-88	180	30-40	3-4	77	2.5	19-11-93	5	PER
378	HDZ	4934	14-09-89	75	30-40	2	62	3.75	19-11-93	5	PER
									TRANSOVA	10	IVF
378	HDZ	4934	03-02-92	40	30	2-3	55	7.5	19-11-93	2	PER
									TRANSOVA	21	IVF
378	HDZ	4934	16-10-93	48							
293	HDZ	4549	19-01-89	170	30-50	2	75	1.5	19-11-93	2	PER

352	HDZ	4908	06-11-92	75	20-50	3-4	70	7.5	19-11-93	2	PER
352	HDZ	4908	28-01-93	50					05-08-93	4	LAJ
352	HDZ	4908	20-01-92	180	<10	2-3	74	4.5	01-07-93	50	UNL
									01-07-93	50	UNL
									19-11-93	2	PER
352	HDZ	4908	06-11-92	190		2.5-3		18	01-11-94	2	PER
352	HDZ	4908	07-01-93	125	10-40	3-4	70	15	01-11-94	2	PER
352	HDZ	4908	28-01-93	140	40-50	3	76	56.5	04-12-93	4	IVF
									01-11-94	2	PER
327	HDZ	4643	03-11-88	100	30-50	3-4	72	1.25	20-11-93	2	PER
327	HDZ	4643	01-06-89	120	20-40	3	78	8	01-11-94	2	PER
377	HDZ	4927	20-04-89	150	40-60	3	80	25	01-11-94	2	PER
377	HDZ	4927	07-06-90	205	30-50	2-3	78	6.25	01-11-94	2	PER
377	HDZ	4927	19-11-91	160	30-40	3	90	7.5	01-11-94	2	PER
332	HDZ	4847	24-04-91	75	20-30	2	56	22.5	01-11-94	2	PER
332	HDZ	4847	06-06-91	180	40-60	2-3	52	18	08-06-93	30	LAJTOJAPAN
									01-11-94	2	PER
332	HDZ	4847	17-04-90	130	30-50	3	74	18	01-11-94	2	PER
332	HDZ	4847	16-05-91	130	30-40	3	74	9.75	08-06-93	30	LAJTOJAPAN
									01-11-94	2	PER
	HDZ	4357	14-11-90	45	<10	3	71	7.25	01-11-94	2	PER
239	HDZ	4228	16-02-90	80	20-40	3	81	25	01-11-94	2	PER
239	HDZ	4228	21-09-89	210	30-50	3-4	86	7	04-12-93	3	IVF
									01-11-94	2	PER
239	HDZ	4228	28-09-89	210	20-40	3	80	11.28	01-11-94	2	PER
286	HDZ	4335	02-10-88	110	40-50	3-4	68	8.5	01-11-94	2	PER
234	HDZ	4024	27-10-88	90	40	3-5	68	4.5	01-11-94	2	PER
234	HDZ	4024	08-12-88	3	40	4	58	-	01-11-94	2	PER
234	HDZ	4024	09-02-89	25	30-40	3	56	5	01-11-94	2	PER
234	HDZ	4024	02-03-89	235	20-40	3-4	61	5	04-12-93	4	IVF
									01-11-94	2	PER
289	HDZ	4478	17-01-92	68	40-50	3-4	76	3	01-11-94	2	PER
195	HDZ	3604	03-02-93	55		2.5			01-11-94	2	PER
195	HDZ	3604	25-02-93	90					01-11-94	2	PER
195	HDZ	3604	12-04-93	158					05-08-93	2	LAJ
									01-11-94	2	PER
195	HDZ	3604	23-08-94	96		3		31	15-10-94	2	PER

285	HDZ	4256	06-06-88	50	10	3	84	2	01-11-94	2	PER
285	HDZ	4256	27-07-89	60	40	1	68	1.5	01-11-94	2	PER
531	SD WAP	WAP 53	02-03-93	48		3		2.5	01-11-94	2	PER
531	SD WAP	WAP 53	02-04-93	30					01-11-94	2	PER
533	SD WAP	WAP 55	03-03-93	39		2-3		1.25	18-11-93	2	PER
533	SD WAP	WAP 55	02-04-93	30							
473	SD WAP	WAP	04-03-93	23		0-1		0	18-11-93	2	PER
441	LAZ	LA	20-02-93	303		3-35		2.5	18-11-93	2	PER
441	LAZ	LA	22-03-93	93		3-4		3.73	18-11-93	2	PER
469	LAZ	LA 9	28-02-93	43		2-3		1.25	18-11-93	2	PER
469	LAZ	LA 9	21-03-93	190							
436	SD WAP	WAP	11-12-92	72 VIALS							
436	SD WAP	WAP	11-12-92	18 VIALS							
534	SD WAP	WAP 56	25-03-93	44							
409	LAZ	LA 6	21-03-93	128		3-4		10	18-11-93	2	PER
	HDZ	5811	18-10-93	310		2-3		3.75	18-11-93	2	PER
255	YULEE		25-10-93	165		3.5		7	01-11-93	2	PER
255	YULEE		18-11-93	180		2.5		3.75	20-11-93	2	PER
255	YULEE		15-12-93			1.5		2.5	20-12-93	2	PER
385	YULEE		28-10-93	280		4		13.75	01-11-93	2	PER
385	YULEE		16-11-93	285		2.5		1.5	22-11-93	2	PER
385	YULEE		15-12-93	149		3.5		3.75	20-12-93	2	PER
385	YULEE		10-94	224							
388	YULEE	8657	27-10-93	70		4		6.25	01-11-93	2	PER
388	YULEE	8657	15-11-93	212		2		2.5	22-11-93	2	PER
388	YULEE	8657	13-12-93	270		1		1	20-12-93	2	PER
455	YULEE	8761	26-10-93	174		3		3.25	01-11-93	2	PER
455	YULEE	8761	16-11-93	172		3		1	22-11-93	2	PER
455	YULEE	8761	14-12-93	209		3		1.25	20-12-93	2	PER
480	YULEE		27-10-93	82		3.5		2	01-11-93	2	PER
480	YULEE		15-11-93	105		3		1.25	22-11-93	2	PER
389	YULEE	8661	25-10-93	115							
389	YULEE	8661	18-11-93	290		4		5.5	22-11-93	2	PER
389	YULEE	8661	13-12-93	310		3.5		2	20-12-93	2	PER

384	YULEE	8551	10-93	150					
384	YULEE	8551	16-11-93	372	3	16.25	22-11-93	2	PER
384	YULEE	8551	14-12-93	322.5	3.5	5	20-12-93	2	PER
T9188	BRONX	881128	03-11-93	211	2	5	15-11-93	2	PER
T9188	BRONX	881128	02-12-93		4	7	15-12-93	2	PER
T9189	BRONX	881284	03-11-93	119	1.5	1	15-11-93	2	PER
T9189	BRONX	881284	02-12-93		3.5-4	2.5	15-12-93	2	PER
425	BRONX	871131	03-11-93	277	3	2	15-11-93	2	PER
425	BRONX	871131	02-12-93	91	3.5	1.5	15-12-93	2	PER
370	BRONX	851281	04-11-93	208	4	7	15-11-93	2	PER
370	BRONX	851281	03-12-93	334	3.5	3.75	15-12-93	2	PER
282	BRONX	821328	04-11-93	267	2-2.5	2.5	15-11-93	2	PER
282	BRONX	821328	03-12-93	187	4	7.25	15-12-93	2	PER
T93004	BROWNSVILLE	4920	18-03-94	125	2.5-3	2.25	15-10-94	2	PER
T93004	BROWNSVILLE	4920	05-11-94	141					
T9221	BROWNSVILLE	4069	18-03-94	176	3	17.5	15-10-94	2	PER
T9221	BROWNSVILLE	4069	03-11-94	142					
T9209	BROWNSVILLE	3956	18-03-94	289	2.5	3.5	15-10-94	2	PER
T9209	BROWNSVILLE	3956	03-11-94	80					
T9170	BROWNSVILLE	4076	18-03-94	213	3	35	15-10-94	2	PER
T9170	BROWNSVILLE	4076	04-11-94	148					
	SD WAP	WAP 53							
378	HDZ	4934	25-08-94	52	3	7.25	15-10-94	2	PER

Henry Doorly Zoo
Gaur Embryo Inventory
12-09-95

Dam Studbook	Sire Studbook	Number	Location	Source
330	336	4	Rafter D Genetics	AI, EC
351	336	7	Rafter D Genetics	AI, EC
501	378	2	TransOva	TVOC, IVF
502	378	2	Henry Doorly Zoo	TVOC, IVF
		1	TransOva	TVOC, IVF
669	239	1	Transferred to 671 on 25-08-95	TVOC, IVF
		1	Transferred to 678 on 25-08-95	TVOC, IVF
671	378	1	Transferred to 672 on 25-08-95	TVOC, IVF
		6	Henry Doorly Zoo	TVOC, IVF
		7	TransOva	TVOC, IVF
672	378	2	TransOva	TVOC, IVF
678	239	1	Thawed 25-08-95 for transfer, not viable	

AI = Artificial Insemination, EC = Transvaginal Embryo Collection,
TVOC = Ultrasound Guided Transvaginal Oocyte Collection, IVF = In Vitro Fertilization

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Rafter D Genetics
7750 Raymond Stotzer Parkway
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(409) 846-7295

Contact Person: Charles Looney, PhD
TransOva Genetics
2938 380th Street
Sioux Center, IA 51250
(800) 999-3586
Fax: (712) 722-3577

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