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Executive Summary

Deer are a unique group of mammals recognized for their grace and beauty. As symbols of nature they play a vital ecological role in many ecosystems, and their economic importance in rural communities is significant. The development of practically every human frontier has relied upon large ungulates as a natural resource, and deer have figured prominently among those species. A number of deer are also prime examples of flagship species, whose continued survival sustains the complex interplay of flora and fauna.

Many species of deer are now under grave threat of extinction, and the situation will not change for the better without a concerted effort. This Action Plan is such an effort, and it has several important objectives. First, it is a reference on the status and distribution of threatened species of deer and a guide to actions required for their conservation. Second, it outlines ways and means of securing updated information on the status of many poorly known populations using the best scientific methods. Third, it lists conservation priorities within each range country and offers a feasible scheme for *in situ* involvement in a large number of range countries where the threats are greatest.

The Action Plan is a comprehensive reference that will be used as a general source of information by the lay public, as well as by range country biologists, university faculty and graduate students, state and federal employees of wildlife, protected area and environmental agencies, and the employees of non-governmental conservation organizations. It is also expected to serve as a reference to wildlife agencies for biodiversity planning, project formulation, and grant writing. The Deer Action Plan is the result of the cooperation of a large number of people from all over the world, most of whom are among the 74 individual Specialist Group members. Over 24 countries are represented within the membership of the IUCN/SSC Deer Specialist Group (DSG).

The *Introduction* sets the stage for the main body of the work with a description of the DSG, the modern context of deer conservation, the conservation philosophy and objectives of the Action Plan, and its methods. The short-term goals and primary challenges to its implementation are also discussed and a breakdown of conservation project training costs is presented.

The *List of Species and Subspecies* encompasses three families of deer and their relatives. The true deer of the family Cervidae are found throughout the New World, Europe, Asia, and North Africa. They range in size from the diminutive pudu of South America and muntjacs of Asia, to the largest species, the moose. The

musk deer of the family Moschidae are found in the high and cold regions of Eurasia. Of moderate size, they lack antlers but are equipped with large dagger-like canine teeth. The musk pod, a specialized scent-producing organ on the belly of males, produces a highly valued musk which is intensively sought as fixative for perfume and for its alleged medicinal properties. The mouse deer and chevrotains are terrier-sized ungulates of the family Tragulidae. They are solitary denizens of tropical forests, and in place of antlers use enlarged canines as weapons.

The body of the Action Plan is divided into four geographic sections: *North America* (including Canada, the United States and Mexico as far as the isthmus of Tehuantepec); *South and Central America*; *Europe, Middle East and Africa*; and *Asia*. Each section contains a synopsis which summarizes the current conservation situation and a list of threatened species by country. The *species accounts* contain detailed descriptions, data, and discussions of all available information. Within each Species Account, status designations are given, based on the *IUCN Red List Categories* (1994). The *distribution and status in the wild* includes a country-by-country listing of protected areas in which the species is known, which can be compared with a more general description of *past distribution and status*. Where applicable, the *status in captivity* is included. The *ecology and reproduction* section summarizes habitat and food preferences, average group size and dispersion patterns, movements, and reproduction, while *uses* describes current patterns of subsistence and commercial exploitation. *Causes of decline and present threats* discusses prevailing problems confronting the species, and *field studies* lists recent and current initiatives to investigate various aspects of ecology. *Conservation action* gives the reader information on various activities in each country, and *recommended conservation action* lists the Deer Specialist Group's recommendations on what is necessary to conserve the species. A comprehensive *Bibliography* provides an extremely useful reference of recent literature on deer conservation. The *Appendices* provide additional useful material for field workers and conservationists.

Funding is a major challenge to the implementation of the Action Plan, but the costs of conducting field work can be quite low, and working at the grass roots level has many rewards. The objective of *Phase One* of the Action Plan is to train developing country personnel specialists. Regional training workshops would give graduate students and field biologists the skills and standardized methodology to conduct population

surveys and ecological studies of threatened deer populations. Participants would conduct short (up to three-month) but intensive surveys of threatened deer in critical areas. Based on the survey information, *Phase Two* would initiate investigations of those populations that are in critical need of ecological information for proper management. In other cases, environmental

education projects will be initiated to understand the nature of “park-people conflicts” and to foster grass-roots support for conservation of specific species of deer in protected or other natural areas. This scheme is based on the time-tested dictum that effective remedies for declining deer populations will be secured only with the use of sound knowledge.

Chapter 1

Introduction

“In general, a great deal of looking for causes must precede the finding of remedies.”

– Garrett Hardin, *Living within Limits* (1993)

Many species of deer, like most large mammals today, are under grave threat of extinction. Several factors symptomatic of profound changes affecting life on earth conspire to create this condition. We can draw little comfort from a review of human demography; in spite of several decades of anguish over the effects of human population growth, and large expenditures by national and international organizations to curb those effects, humanity is virtually swarming, particularly in regions which harbor the greatest biodiversity. Of various human activities inimical to wildlife, direct exploitation in the form of legal and illegal hunting is often the primary cause of the demise of large mammals, including deer. The reason is obvious: deer are large and their meat is tasty.

Many other reasons can be cited to explain the decline of particular species, but ultimately, the explanation boils down to the inability of *Homo sapiens* to govern its reproduction, and its slavery to the dogmas of economic growth and consumerism. The future of wildlife and wilderness seems to have little hope when these facts are compounded with humankind's increasing alienation from nature, and the addictions of urban living.

On the positive side, there is a growing global awareness of the importance of nature to human welfare. The United Nations Conference on Environment and Development (UNCED) meeting in Rio de Janeiro in June 1992 is testimony to the willingness of nations of all colors to heed the interdependence of environmental health and human welfare. Unfortunately, the technological world, the juggernaut of economic gain, usually turns a deaf ear to voices predicting the apocalyptic future being wrought by short-sighted policies and practices. It is a disturbing view worth emphasizing, because within their professional microcosm biologists often embrace nature while ignoring its demise (Janzen, 1986). While it is satisfying to be a biologist, none of us can afford to ignore the dark clouds on the horizon. The IUCN Species Survival Commission offers field biologists the opportunity to become the foot soldiers of conservation, not only by providing information on wildlife, but more importantly, by implementing Action Plan initiatives.

The IUCN/SSC Deer Specialist Group (DSG)

This Action Plan has been prepared by the IUCN/SSC Deer Specialist Group (DSG), a body of ecologists, conservation

biologists, managers, and administrators embracing disciplines vital for species recovery. The DSG, with 74 members representing 24 countries, is devoted specifically to the conservation of the Cervidae. Thirty-six percent of the membership resides in developing countries where the diversity of cervid species is greatest. Like some other Specialist Groups, the DSG is organized into regional sections headed by coordinators who have knowledge and experience of the ecology and natural history of their region. Regional coordinators are conduits of information to and from the Chair, the membership, and between geographic realms, and they are responsible for soliciting contributions to the annual newsletter. They will play an important role coordinating the implementation of recommendations contained in this Action Plan.

The Action Plan is the basic document guiding conservation action for each Specialist Group (Gimenez-Dixon and Stuart 1993). The usual method of developing an Action Plan is to survey a large number of individuals, agencies, and non-governmental organizations likely to be knowledgeable about the threatened taxa in question or their habitats. The process involves sending one or more successive waves of questionnaire mailings as additional field workers emerge. Recent publications and unpublished government and agency reports are also consulted. Based on this information, a set of recommendations is developed for each species under threat, with recommended projects for protection, research, and management. This Action Plan encompasses all taxa of known threatened status, but also includes taxa of unknown status. Taxa that are common and managed, for example most subspecies of white-tailed and red deer, are not treated in the Action Plan.

The Deer Action Plan

The modern context of deer conservation

The problems of environmental conservation almost always involve an interaction between biological and human components. Divorced from the human context, biological problems are often relatively easy to solve. However, the biological issues that conservationists grapple with are frequently the product of the complexities of human behavior. In the short-term, we can protect important natural landscapes and threatened species, but unless patterns of human behavior change, a sustainable balance

between the needs of humans and nature will not be attained. Establishing this balance is the ultimate conservation challenge; one which is clearly beyond the reach of Specialist Groups. The goal of this Action Plan is to provide a sound scientific basis for prioritizing measures needed in the short-term to conserve deer species, and to stem the decline of populations of severely threatened species.

The conservation philosophy of this Action Plan

This Action Plan benefits from the views of a number of active members with extensive field experience in the developing world, and reflects an international conservation perspective that is sensitive to the goals of the plan. This perspective is particularly germane to this plan since most threatened cervids occur in developing countries and the recovery process will require collaboration between nations. For further background on the issue the reader is referred to Pearson (1985), Mares (1991), Colvin (1992), Robinson and Wemmer (in press), and Wemmer and Robinson (in press). This viewpoint is reflected in the following in-situ and ex-situ conservation goals.

In-situ conservation

Conservation of populations in nature is the primary purpose of the Action Plan, and there are five specific goals.

1. *Facilitate local involvement in the implementation process by training range country nationals.* While implementing recommendations, it is desirable to advance the education of range country nationals by providing opportunities as field researchers and assistants (see Rudran *et al.* 1990). Every effort should be made to support the involvement of range country assistants or counterparts when foreign zoologists and conservation biologists are able to generate funds.
2. *Foster commitment among range country biologists by supporting their involvement, and when possible, by providing incentives.* Limited opportunities for employment in field biology, wildlife management, and conservation often discourage the pursuit of careers in conservation, particularly in developing countries. This fact has not stemmed a steady tide of recruits who are interested and committed to environmental causes. These developing country nationals are available to implement various Action Plan recommendations. Graduate education and in-service training are powerful incentives to biologists.
3. *Help range country agencies and NGOs secure resources to strengthen protected area and wildlife management and reinforce the work of implementors.* Funding opportunities for biodiversity conservation are often found in developed nations, and require a writing style and special knowledge not accessible to many range country biologists. Deer specialists from non-range countries should make every effort to help colleagues draft proposals for external funding.
4. *Whenever possible help build the capacity of local agencies/NGOs.* Many large mammals are attractive and “charismatic” and thus have potential for ecotourism. The role of large mammals in ecotourism can be enhanced when ecologists take the time and effort to transfer ecological knowledge to naturalists and interpreters employed by protected areas, hotels, and tourist agencies.
5. *Increase environmental awareness of the public through education initiatives linked to conservation projects.* Protected areas, zoos, and museums are existing platforms for environmental education. Non-governmental conservation organizations can serve the same purpose through newsletters and issue-related campaigns. Ongoing programs in these organizations are driven by funding for specific projects, but additional funds must be generated to implement education goals for particular threatened species of deer.

Ex-situ conservation

The role of ex-situ initiatives in the larger sphere of conservation has received vigorous advocacy (Seal 1986), and attracted critical commentary (MacKinnon 1991; Hutchins *et al.* 1995 and Snyder *et al.* 1992). We wish to set forth the philosophy of this Action Plan in light of this dialogue. For additional details and guidelines of ex-situ conservation see Wemmer and Anderson (1991).

1. Given that resources are usually limited, priority should be given to in-situ deer conservation. Quite apart from ethical considerations, comparative studies have shown that for large mammals such as deer this is the most cost effective option.
2. Threatened cervids exist in many range country zoos in Asia and Latin America, but their use in conservation education, management, and husbandry is often wanting (Wortman *et al.* 1991). The DSG endorses properly structured captive propagation programs of threatened cervids that have clear objectives, particularly in well-designed zoological facilities in range countries. Genetic and demographic management, sound

husbandry, and veterinary care are the immediate requirements of such programs, which must be part of an overall conservation strategy. There are several reasons for this position.

First, threatened species are compelling symbols of conservation need, which lend themselves well to public education of environmental issues. Educational campaigns about threatened species issues have considerable conservation potential, especially in range countries. Education, however, will be most effective in zoo settings where the animals are healthy and high standards of exhibition and husbandry are evident.

Second, biological information on life history parameters can be gathered in zoos with minimal effort and expense. Much remains to be learned about the reproductive biology and behavior of most threatened deer. Developing country zoos regularly receive many little known species of wildlife and can contribute significantly to knowledge by maintaining zoological records and publishing findings. More sophisticated and costly research methodologies (e.g. urinary hormonal monitoring) can also be used to quickly document reproductive cycling, but most of these projects will have to rely upon external funding based upon international collaboration.

Third, captive stocks may prove helpful in reintroduction projects when genetic history is known, and the animals have been properly prepared for wild conditions. Reintroduction can be a useful tool for species recovery, but requires careful planning (Wemmer and Derrickson 1987; Kleiman 1989; and Stanley-Price 1989) and should not be passed off as a simple technological solution.

3. Captive breeding programs should not be undertaken on threatened deer species whose populations exist only in the wild unless:
 - a) the numbers are low, threats can not be mitigated, and the population is clearly doomed to extinction in the immediate future;
 - b) a written recovery plan has been prepared and endorsed by range country officials of appropriate environmental agencies, and commitment and funding for recovery is assured; and
 - c) appropriate facilities and trained personnel exist to maintain an expanding captive population, or funding and plans exist for facility construction, staffing, and maintenance.

Action Plan objectives

In addition to the general goals of IUCN Action Plans, this plan has three primary conservation objectives, as follows:

1. Determine the status of poorly known populations using scientifically proven methodology. Since the status of many taxa may be classed as "Data Deficient," conducting status surveys of these species is a *de facto* priority.
2. Develop species conservation priorities within each range country. Conservation priorities have been assigned on a geographic basis at the national level.
3. Establish priorities for conservation action according to the following factors:
 - a) species' populations within and outside of protected areas, including size, age structure, habitat characteristics, etc.;
 - b) adequacy of protection afforded to populations within protected areas (including staffing, infrastructure, proximity and size of adjacent communities, current management, existing protection measures, etc.);
 - c) the nature of the threats to the population, i.e.,
 - direct species-specific threats such as hunting (over-exploitation of the species as a resource)
 - indirect threats such as grazing, habitat conversion, deforestation, etc.

The target audience of the Action Plan

This Action Plan has several audiences. We hope it will be used by the interested lay public as a source of general information on cervid conservation. The country and species listings of projects are intended for the use of range country biologists, in particular, university faculty and graduate students, state and federal employees of wildlife, protected area, and environmental agencies, and the employees of non-governmental conservation organizations. It is also expected to serve as a reference for biodiversity planning, project formulation, and grant applications for wildlife agencies.

Methods

Compilation of species accounts

The DSG initiated its species survey in 1991 using a questionnaire modeled after that used by the Pigs and Peccaries Specialist Group. A small meeting was convened in 1992, and during a busy but pleasant week of confinement at the Conservation & Research Center (CRC) the group succeeded in compiling the first draft of the Action Plan. A decision tree for determining action was also drafted at that time (Appendix 1). Several gaps in the data were discovered, and a second mailing of questionnaires was

made in the spring of 1993. The Action Plan rested peacefully until early 1994 when Andrew McCarthy was contracted to review, edit, and compile missing species accounts. In early 1995 Raleigh Blouch was contracted to review the manuscript and update the species accounts with the latest information. The World Conservation Monitoring Centre (Cambridge) provided the compilation of deer species and protected areas. For the purposes of the Deer Specialist Group, regional subdivisions are based on both political and biogeographic factors. North America includes Canada, the USA, and Mexico to the Isthmus of Tehuantepec. Central America includes the Meso-American nations and southern Mexico below the Isthmus. South America of course coincides with the continent. The Eurasian land mass is not so easily partitioned. Afghanistan, Pakistan, and the Islamic Republics of the former Soviet Union have been included within Asia. Since most of the species accounts were written during the period of the Soviet breakup, we have not updated regions on a national basis. While species accounts refer to the "former USSR", they usually include specific locations.

Finally, we have used the convention of zoological parks to designate sex ratios (e.g. 10.5.3), where the first number refers to the number of males, the second number refers to females, and the third to unsexed individuals. Use of the term "synonym" ("syn." in the text) refers only to the name immediately following, and alerts the reader that both names refer to the same taxon. The term "inseparable" means that the taxon cannot be taxonomically distinguished on the basis of external characters.

IUCN/SSC introduced a new threatened categories system in 1994, which has been applied to deer for the purposes of this Action Plan and the production of the 1996 Red List of Threatened Animals. The new categories are summarily defined in Appendix 4. It should be noted that all classifications are best estimates based on available information. In addition, this report includes taxa and status designations which were not included in the latest IUCN classification.

The recommendation and implementation process

A wide range of recommendations can be found in existing IUCN/SSC Action Plans. Recommendations address research issues (e.g. status surveys, ecological and genetic studies), protected area management (establishing new parks, improving management capacity, creating buffer zones, and connecting corridors), the control of trade and regulation of "take," and specific prescriptions for population recovery (e.g. translocation and reintroduction). The appropriate implementors of recommendations (i.e. research scientists, academics, government agencies, and NGOs) are usually implicit, and are not mentioned.

A description of the biopolitical dimension of conservation in range countries was beyond the scope of the Specialist Group, since the legal authority over wildlife and protected areas differs widely.

Like other SSC Specialist Groups we have identified a wide range of threats, and have prescribed actions believed necessary for their mitigation. We acknowledge that the complexity, feasibility, and costs of conserving threatened species crosses biological, social, economic, and political boundaries. Higher order conservation goals (e.g. protected area management and community development) are intangible to most, if not all Specialist Groups. Even so, we have not restricted the scope of our analysis of threats, but rather have narrowed our recommendations to those actions which are feasible for the DSG considering existing constraints of time and funding. In short, our goal has been to concentrate on conservation actions which involve minimal biopolitical complexity. In the following paragraphs we have developed a framework for implementation based on the philosophy of the Chair, the Vice Chair, and regional coordinators.

Major challenges to implementation

Securing funds for projects. Funding for the implementation of Action Plans is not provided by IUCN upon completion of the plan. One of the reasons for this is that the revenue from sales of Action Plans does not cover production costs (i.e. distribution for conservation work is given priority over revenue). International NGOs, the major potential donors for Action Plan implementation, do not generally recognize threatened species recovery as a priority for funding. They tend to favor action at the national level, such as drafting national biodiversity plans, National Conservation Strategies, protected area plans, and high-tech solutions such as remote sensing, geographic information systems, landscape ecology, and so-called capacity building. Thus, there is a fundamental mismatch in focus and approach between the goals of the Specialist Groups and those of the NGOs which may be called upon to finance implementation. Nevertheless, the costs of conducting field work can be quite economical (for estimates of average cost, see Matrix of Conservation Actions below).

Undertrained field biologists. A critical potential factor limiting implementation of Action Plan projects is the number of field biologists in developing countries (Mares 1991, Wemmer *et al.* 1993).

Implementation plan

This Action Plan envisions several steps necessary for implementation, as follows:

1. *Seek qualified candidates to implement projects specified in the Action Plan.*
 - a) Regional Coordinators (RCs) screen potential candidates through their in-country network, and document candidate qualifications (résumés, letters of recommendation, transcripts).
2. *Determine logistical arrangements necessary to support the “implementors”.*
 - a) Regional Coordinators determine the logistical support available at the study sites (private or protected areas, field stations etc.), either directly or through colleagues having first-hand experience.
 - b) Regional Coordinators determine costs of lodging, local transportation, and “incidentals”; use this to determine salary levels for researchers of differing educational background (B.S., M.Sc., or Ph.D).
3. *Identify prospective funding organizations and donors.*
 - a) Chair/Vice Chair explore possible sources of support through existing programs of the BONGOs (“Big Old NGOs”, such as WWF-US/International, etc.) and BINGOs (“Big New NGOs”), Eco-tourism operators, and MULTILATS (Multilateral Development Agencies).
 - b) Regional Coordinators explore possible support by LINGOs (“Little NGOs” in the range countries) and BILATS (Bilateral Development Agencies).
4. *Draft proposals and submit to funding organizations.*
 - a) Chair and Vice-Chair prepare proposals based on the Action Plan and feedback from Regional Coordinators. Submit the proposals to BONGOs and BINGOs for financial assistance.
 - b) Range countries submit the same or modified proposals to DINGOs (“Developing Country NGOs”) which in turn solicit funding from BONGOs, BINGOs, and BILATS.
5. *Train implementors (once funding is secured).*
 - a) Field Surveys and Research Projects: If sufficient funding can be secured, conduct a Field Methods Training Course in Asia and Latin America. This

training would include instruction and hands-on demonstrations of population censusing methods, habitat analysis, body condition and reproductive assessment, etc. (purpose: incentive, build team spirit, standardize methods, reinforce a network of DSG co-workers).

- b) Environmental Education Projects: Training in Environmental Education Methods is also required where threats to populations can be reduced by better public understanding and local community support for deer conservation and sustainable use. Funding should be secured for regional training sessions in Latin America and Asia, or in a country where such training is available (e.g. the North American Association for Environmental Education, NAAEE). Such training should result in specific educational initiatives that can be supported and implemented by local NGOs.

If limited funding is secured: contract one or more “roving” Latin American and/or Asian field biologist(s) to teach methodology either at a single site, or at consecutive sites (depending on funds). If the Training Course is given, a workshop or follow-up consultation would also take place as a means of maintaining quality control, to positively reinforce field workers, and to provide technical advice and assistance.

6. *Assess implementation with a follow-up workshop (one year later).*
 - a) Field Surveys and Research Projects: To be hosted in Latin American and Asian range countries or in the U.S. (depending on funding), this workshop would assist the implementors in analyzing and interpreting data, and in drafting manuscripts for publication in refereed journals. The workshop would provide a means for the DSG to evaluate the success of the method.
 - b) Environmental Education Projects: Assessment of education project results would take place through two regional workshops (Latin America and Asia), preferably hosted at a central location in each region.

Matrix of Conservation Actions and Implementation Factors.			
Conservation action	Implementor	Estimated cost (US\$)	Time frame
status survey	graduate students	<2,500/yr.	<1 yr.
ecological research	graduate students	5,000–10,000/yr	1–2 yrs
education program	NGOs, wildlife departments	5,000–10,000/yr.	1–2 yrs.
population monitoring	wildlife department staff; university departments and other research institutions	500/yr.	annually
habitat management	wildlife department staff	variable	periodically

List of Species and Subspecies of the Families Tragulidae, Moschidae, and Cervidae

Peter Grubb and Alfred L. Gardner

Taxonomy is the foundation of biodiversity conservation, and this listing of taxa in Table 1 (families, species and subspecies) is intended as a convenient reference to users of the Action Plan. It is an abbreviation of the comprehensive list prepared by Grubb (1993), with lists of subspecies and general information regarding distribution provided by Dr Alfred Gardner. The list includes subspecies of most species. It was not possible to list all subspecies for a small number of species because of uncertain taxonomic status. For the purposes of this Action Plan, cervid taxa have been alphabetized irrespective of subfamily.

The taxonomy of the Cervidae, Moschidae, and Tragulidae is not a refined science, and the evolution and zoogeography of the group has a complex history (van Bemmelen 1973). The legitimacy of a significant

number of taxa will never be known because the original populations no longer exist (e.g., *Cervus duvauceli ranjitsinhi*, *Cervus nippon grassianus*), but validating the genetic distinctness of extant subspecies and isolated populations remains an important goal, with implications for conservation. Ironically, the recent discovery of several new species of deer (*Mazama pandora*, *Mazama bororo*, and *Megamuntiacus vunuangensis*) tells us that nature has not yet divulged all of its larger secrets. Molecular technology is now disclosing unsuspected taxonomic relationships, clades, and hybridization (Carr and Hughes 1993; Carr 1997), and promises to clarify nagging issues in the evolutionary history of deer. Unfortunately, many logistical and financial obstacles make this difficult.

Table 1. List of Species and Subspecies of the Families Tragulidae, Moschidae, and Cervidae.					
Species	Subspecies	Common name	1996 IUCN Red List ¹	CITES ²	Countries within range
Family: TRAGULIDAE					
* <i>Hyemoschus aquaticus</i> Ogilby, 1841		water chevrotain	LR nt (DSG: DD)	III (Ghana)	Cameroon, Dahomey, Dem. Rep. Congo, Ghana, Ivory Coast, Liberia, Nigeria, Sierra Leone, Togo, Uganda,
<i>Moschiola meminna</i> Erxleben, 1777		chevrotain or Indian mouse deer	LR lc		Peninsular India, Nepal, Sri Lanka
<i>Tragulus javanicus</i> Osbeck, 1765		lesser mouse deer or Kanchil	LR lc		Over 30 named subspecies, most insular
<i>Tragulus napu</i> F. Cuvier, 1822		Napu or greater mouse deer	LR lc		Over 30 named subspecies, most insular
*	<i>T. n. nigricans</i>	Balabac mouse deer	(DSG: DD)		Philippines (Balabac Island, Palawan Island?)
Family: MOSCHIDAE					
* <i>Moschus berezovskii</i>		forest musk deer	LR nt	II	China, Vietnam
	<i>M. b. anhuiensis</i> Wang, Hu & Yan, 1982				China (Anhui)
	<i>M. b. berezovski</i> Flerov, 1929				China (Shaanxi, Hubei, Sichuan, Gansu, Tibet ?)
	<i>M. b. caobangis</i> Dao, 1969				Vietnam, China (Guanxi, Yunnan)
* <i>Moschus chrysogaster</i> (<i>chrysogaster</i> ssp. group)		Alpine musk deer	LR nt	I II (China)	China, India
	<i>M. c. chrysogaster</i> Hodgson, 1839				China (Tibet), Sikkim
	<i>M. c. sifanicus</i>				China (Qinghai, Sichuan)
	ssp. nov., Gongshan race Przewalskii, 1888 or Buchner, 1890				China (Yunnan)

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* <i>Moschus chrysogaster</i> (<i>leucogaster</i> ssp. group)		Himalayan musk deer	LR nt	I II (China)	Afghanistan, China, India, Nepal, Pakistan
	<i>M. c. cupreus</i> Grubb, 1982				Afghanistan, Kashmir, Pakistan
	<i>M. c. leucogaster</i> Hodgson, 1839				Nepal, Sikkim
	ssp. nov., Kulu race				India
	ssp. nov., Zhangmu/ Khumjung race (<i>chrysogaster</i> of Cai & Feng 1981)				China (Tibet), Nepal
* <i>Moschus fuscus</i>		black musk deer	LR nt	II	Bhutan, China, India, Myanmar, Nepal
	<i>M. f. fuscus</i> Li, 1981				Burma, China (Yunnan, Tibet), India ('Assam')
	ssp. nov., Everest/ Khumbu race				Bhutan, Nepal, Sikkim
* <i>Moschus moschiferus</i>		Siberian or Taiga musk deer	VU (A1acd)	II	China, Korea, Mongolia, former USSR
	<i>M. m. moschiferus</i> Linnaeus, 1758				China (Sinkiang), Mongolia, former USSR
	<i>M. m. parvipes</i> Hollister, 1911				China (Heilongjiang, Jilin, Hebei, Shanxi), Korea.
	<i>M. m. sachalinensis</i> Flerov, 1929				Former USSR (Sakhalin)
Family: CERVIDAE					
<i>Alces alces</i> (<i>alces</i> ssp. group)		elk (elch) or moose			
	<i>A. a. alces</i> Linnaeus, 1758				China (Sinkiang), Finland, Mongolia ?, Norway, Poland, Sweden, former USSR
	<i>A. a. caucasica</i> Vereschagin, 1955				Former USSR (Caucasus), extinct
* <i>Alces alces</i> (<i>americana</i> group) Clinton, 1822		moose			China (Manchuria), Mongolia, former USSR
	<i>A. a. cameloides</i> Milne-Edwards, 1867	Eurasian moose or elk	LR nt		China, eastern Mongolia
	<i>A. a. americana</i> , syn. <i>andersoni</i> Peterson, 1950				Alaska, Canada, USA
	<i>A. a. shirasi</i> Nelson, 1914;				Alaska, Canada, USA
	<i>A. a. gigas</i> Miller, 1899				Alaska, Canada, USA
	<i>A. a. buturlini</i> Chernyavsky & Zheleznov, 1982				
	<i>A. a. pfizenmayeri</i> Zukowsky, 1920				
<i>Axis (Axis) axis</i>	<i>A. a. axis</i> Erxleben, 1777	Chital or Indian spotted deer			Bangladesh, India, Nepal, Sri Lanka. Introduced to Andaman Islands, Argentina, Australia, Brazil, Hawaiian Islands, New Guinea, USA, Yugoslavia
* <i>Axis (Hyelaphus) calamianensis</i>		Calamian deer	EN (B1+3d)		Calamian Islands, Philippines
* <i>Axis (Hyelaphus) kuhli</i>		Bawean deer	EN (D1)		Indonesia, Bawean Island
	<i>A. k. kuhli</i> Muller, 1840				Indonesia, Insular: Bawean

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* <i>Axis (Hyelaphus) porcinus</i>		hog deer			Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Pakistan, Sri Lanka (introduced?), Vietnam. Introduced to Australia, Maryland in USA
*	<i>A. p. annamiticus</i> Heude, 1888	Indo-chinese hog deer	DD	I	China (Yunnan), Cambodia, Laos, Thailand (extinct), Vietnam
*	<i>A. p. porcinus</i> Zimmermann, 1780		LR nt	Not listed	India, Myanmar, Nepal, Pakistan, Sri Lanka (feral?)
* <i>Blastocerus dichotomus</i>	<i>B. d. dichotomus</i> Illiger, 1815	marsh deer	VU (A2cde)	I	Argentina, Bolivia, Brazil, Paraguay, Peru, Uruguay
<i>Capreolus capreolus</i>		roe deer			
	<i>C. c. capreolus</i> Linnaeus, 1758				Europe excluding Iran, Iraq, Israel (extinct), Lebanon (extinct), Mediterranean Islands, Syria, Turkey, former USSR (Caucasus region)
	No ssp., except perhaps <i>coxi</i> Cheesman & Hinton, 1923				Iraq
<i>Capreolus pygargus</i>		Siberian roe deer			
	<i>C. p. bedfordi</i> Thomas, 1908, syn. <i>melanotis</i> (Miller, 1911)				China (Gansu, Shanxi, Manchuria), Korea, former USSR
	<i>C. p. pygargus</i> Pallas, 1771, syn. <i>caucasica</i> (Dinnik, 1910)				USSR
	<i>C. p. tianschanicus</i> Satunin, 1906				China (Sinkiang), Mongolia, former USSR (Russia, Kazakstan, S. Siberia)
* <i>Cervus (Przewalskium) albirostris</i>					
	<i>C. a. albirostris</i> Przewalski, 1883	White-lipped or Thorold's deer	VU (C1)		China (Tibet, Sichuan, Qinghai)
* <i>Cervus (Rusa) alfredi</i>		Prince Alfred's or Philippine spotted deer	EN (B1+2c)		Panay and Negros Islands, Philippines (Visayas Islands)
	<i>C. a. alfredi</i> Sclater, 1876				Panay and Negros Islands, Philippines (Visayas Islands)
	<i>C. c. calamianensis</i> Heude, 1888				Calamian Islands, Philippines
* <i>Cervus (Rucervus) duvauceli</i>		swamp deer or barasingha	VU (C1)	I	Introduced to Texas in USA
*	<i>C. d. branderi</i> Pocock, 1943		EN (D1)		India
*	<i>C. d. duvauceli</i> Cuvier, 1823		VU (C1)		India, Nepal
*	<i>C. d. ranjitsinhi</i> Groves, 1982		CR (C2b)		India, Bangladesh (extinct)
<i>Cervus elaphus (elaphus ssp. group)</i>		red deer	LR lc		Introduced to Argentina, Australia, Chile, Morocco, New Zealand, USA
	<i>C. e. atlanticus</i> Lönnerberg, 1906				Norway
*	<i>C. e. barbarus</i> Bennett, 1833	barbary stag or Atlas deer	LR nt	III (Tunisia)	Algeria, Tunisia, Morocco (extinct)
	<i>C. e. bolivari</i> Cabrera, 1911				northern Spain
	<i>C. e. braueri</i> Charlemagne, 1920				Europe, former USSR

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*	<i>C. e. corsicanus</i> Erleben, 1777		EN (D1)		Corsica (extinct), Sardinia (feral?)
	<i>C. e. elaphus</i> Linnaeus, 1758				Sweden
	<i>C. e. hippelaphus</i> Erleben, 1777				Belgium
	<i>C. e. hispanicus</i> , (inseparable with <i>corsicanus</i> ?) Hilzheimer, 1909				southern Spain
	<i>C. e. maral</i> Ogilby, 1840	maral			Iran, Turkey, former USSR
	<i>C. e. montanus</i> Botezat, 1903				Carpathian Mountains
	<i>C. e. scoticus</i>				Britain
<i>Cervus elaphus</i> (<i>wallichi</i> ssp. group)					
*	<i>C. e. affinis</i> Hodgson, 1841	Shou	DD		Bhutan, China (Tibet)
*	<i>C. e. bactrianus</i> Lydekker, 1900	bactrian deer	VU (D1)	II	Afghanistan, former USSR
	<i>C. e. hanglu</i> Wagner, 1844	hangul or Kashmir stag	EN (D1)		Kashmir, India
	<i>C. e. kansuensis</i> Pocock, 1912	Kansu stag			China (Gansu)
*	<i>C. e. macneilli</i> Lydekker, 1909	MacNeill's stag	DD		China (Sichuan, Tibet)
*	<i>C. e. wallichi</i> Cuvier, 1823	Wallich's stag	DD		China (Tibet, extinct?) Nepal (extinct)
*	<i>C. e. yarkandensis</i> Blanford, 1892	Yarkand stag	EN (A1a)		China (Sinkiang)
<i>Cervus elaphus</i> (<i>canadensis</i> ssp. group)					
*	<i>C. e. alashanicus</i> Bobrinskii & Flerov, 1935		DD		China (Inner Mongolia)
	<i>C. e. canadensis</i> Erleben, 1777				Canada, USA
	<i>C. e. manitobensis</i> Millais, 1915				Canada, USA
	<i>C. e. merriami</i> Nelson, 1902				Canada, USA
	<i>C. e. nannodes</i> Merriam, 1905				Canada, USA
	<i>C. e. roosevelti</i> Merriam, 1897				Canada, USA
	<i>C. e. sibiricus</i> Severtzov, 1873				China (Sinkiang), Mongolia, former USSR
	<i>C. e. songaricus</i> Severtzov, 1873				Dzungarian Tien Shan
	<i>C. e. xanthopygus</i> Milne-Edwards, 1867				China (Manchuria), former USSR
	<i>C. e. nelsoni</i> V. Bailey, 1935				Mexico (extinct), USA, Canada
* <i>Cervus (Rucervus) eldi</i>		Eld's deer, brow-antlered deer, Thamin, Sangai	VU (A2c)	I	India
*	<i>C. e. eldi</i> M'Clelland, 1842		CR (B1+2c, C2b)		India (Manipur)

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*	<i>C. e. siamensis</i> Lydekker, 1915		DD		Thailand, Laos, Thailand (extinct) Cambodia, Vietnam (extinct ?), China (Hainan)
*	<i>C. e. thamin</i> Thomas, 1918		LR nt		Burma, Thailand
* <i>Cervus (Rusa) mariannus</i>		Philippine deer	DD		Philippines
	<i>C. m. barandanus</i> Heude, 1888				Philippines (Mindoro)
	<i>C. m. boninensis</i> Lydekker, 1905				Bonin I. (feral ?)
	<i>C. m. mariannus</i> Desmarest, 1822				Philippines (Luzon), Mariana Islands (incl. Guam, feral); Caroline Islands (feral)
	<i>C. m. nigellus</i> Hollister, 1913				Philippines (mountains of Mindanao)
	<i>C. m. nigricans</i> Brooke, 1876				Philippines (Basilan, Mindanao)
* <i>Cervus (Cervus) nippon</i>		Sika			Introduced to Britain, Czechoslovakia, Denmark, France, Germany, Ireland, Madagascar, USA, Azerbaijan, Oshima I. in Japan
*	<i>C. n. aplodontus</i> Heude, 1884		DD		Japan (Kerama Is.)
*	<i>C. n. grassianus</i> Heude, 1884		CR (C2a)		China (Sichuan)
	<i>C. n. hortulorum</i> Swinhoe, 1864				China, Vietnam
*	<i>C. n. keramae</i> Kuroda, 1924		CR (C2a)		Japan (Tsushima Is.)
*	<i>C. n. kopschi</i> Swinhoe, 1874		EN (D1)		Philippines (Sulu Is., feral ? extinct?)
*	<i>C. n. mandarinus</i> Milne-Edwards, 1871		CR (D1)		China (extinct ?)
*	<i>C. n. mantchuricus</i> Swinhoe, 1864		DD		China, former USSR.
	<i>C. n. nippon</i> Temminck, 1838				Japan (N. Honshu)
*	<i>C. n. pseudaxis</i> Eydoux & Souleyet or Gervais, 1841		CR (D1)		Vietnam
*	<i>C. n. pulchellus</i> Imaizumi, 1970		DD		Japan
*	<i>C. n. sichuanicus</i> Guo, Chen & Wang, 1978		EN (D1)		Japan (Hokkaido)
	<i>C. n. soloensis</i> Heude, 1894				Japan (S. Honshu, Kyushu, Shikoku etc.).
*	<i>C. n. taiouanus</i> Blyth, 1860		CR (D1)		Taiwan
*	<i>C. n. yesoensis</i> Heude, 1884		DD		Taiwan (extinct in wild)
<i>Cervus (Rucervus) schomburgki</i>	<i>C. s. schomburgki</i> Blyth, 1863	Schomburgk's deer			Thailand, extinct
<i>Cervus (Rusa) timorensis</i>		rusa, Timor deer			Introduced to Anjouan in Comoro Is., Amboina, Australia, Borneo (extinct), Madagascar, Mauritius, New Caledonia, New Zealand, Sulawesi
	<i>C. t. djonga</i> Van Bemmelen, 1949				Indonesia (Muna Is., feral ?)
	<i>C. t. floresiensis</i> Heude, 1896				Indonesia (Lesser Sundas)

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	<i>C. t. macassaricus</i> Heude, 1896				Indonesia (Sulawesi, etc., feral ?).
	<i>C. t. moluccensis</i> Quoi & Gaimard, 1830				Indonesia (Sula Is., Buru, Ceram etc., feral ?)
	<i>C. t. renschi</i> Sody, 1933				Indonesia (Bali)
	<i>C. t. russa</i> Muller & Schlegel, 1845				Indonesia (Java)
	<i>C. t. timorensis</i> de Blainville, 1822				Indonesia (Timor etc., feral ?)
<i>Cervus (Rusa) unicolor</i>		sambar			Introduced to Australia, New Zealand, USA
	<i>C. u. brookei</i> Hose, 1893				Indonesia/Malaysia (Borneo)
	<i>C. u. cambojensis</i> Gray, 1861				Cambodia, China (Yunnan, Guangxi), Laos, Myanmar, Thailand, Vietnam
	<i>C. u. dejeani</i> Pousargues, 1896				China (Sichuan, Guizhou, Hunan, Jiangxi)
	<i>C. u. equinus</i> Cuvier, 1823				Indonesia (Sumatra), Malaysia (Malaya)
	<i>C. u. hainana</i> Xu, 1980				China (Hainan)
	<i>C. u. swinhoei</i> Sclater, 1862				Taiwan
	<i>C. u. unicolor</i> Kerr, 1792				India, Sri Lanka
<i>Dama dama</i>		fallow deer	LR lc		Introduced to Argentina, Australia, Chile, most European countries, Fiji Islands, Leeward Islands, Peru, South Africa, Uruguay, USA
	<i>D. d. dama</i> Linnaeus, 1758				Natural distribution in historic times not defined, includes Turkey.
*	<i>D. d. mesopotamica</i> Brooke, 1875	Persian fallow deer	EN (D1)		Iran, Iraq (extinct ?), Jordan (extinct), Israel (extinct), Lebanon (extinct)
* <i>Elaphodus cephalophus</i>		tufted deer	DD		
*	<i>E. c. cephalophus</i> Milne-Edwards, 1872		DD		China (Sichuan, Yunnan), Myanmar
*	<i>E. c. fociensis</i> Lydekker, 1904		DD		China (Fujian)
*	<i>E. c. ichangensis</i> Lydekker, 1904		DD		China (Hubei)
*	<i>E. c. michianus</i> Swinhoe, 1874		DD		China (Zhejiang, Fujian)
* <i>Elaphurus davidianus</i>	<i>E. d. davidianus</i> Milne-Edwards, 1866	Milu or Pere David's deer	CR (D1)		China (extinct in wild, but re-established in fenced reserves)
* <i>Hippocamelus antisensis</i>	<i>H. a. antisensis</i> D'Orbigny, 1834	Taruca	DD	I	Argentina, Bolivia, Chile, Ecuador (extinct), Peru
* <i>Hippocamelus bisulcus</i>	<i>H. b. bisulcus</i> Molina, 1882	Huemul	EN (C2a)	I	Argentina, Chile
* <i>Hydropotes inermis</i>		Chinese water deer	LR nt		Introduced to Britain, France
*	<i>H. i. argyropus</i> Heude, 1884		DD		Korea
*	<i>H. i. inermis</i> Swinhoe, 1870		LR nt		China
* <i>Mazama americana</i> (<i>americana</i> ssp. group)		red brocket	LR lc (DSG: DD)		
	<i>M. a. americana</i> Erxleben, 1777				Ecuador, Trinidad
	<i>M. a. carrikeri</i> Hershkovitz, 1959				Ecuador, Trinidad

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	<i>M. a. gualea</i> , <i>M. a. trinitatis</i> (insular, Trinidad) & <i>M. a. zamora</i> J.A. Allen, 1915				Ecuador, Trinidad
	<i>M. a. jucunda</i> , <i>M. a. sheila</i> , & <i>M. a. zetta</i> Thomas, 1913				Ecuador, Colombia, Venezuela, Trinidad, Guyana, Suriname, French Guiana, Brazil, Argentina, Bolivia, Paraguay, Peru
	<i>M. a. rosii</i> & <i>M. a. toba</i> Lönnberg, 1919				Ecuador, Colombia, Venezuela, Trinidad, Guyana, Suriname, French Guiana, Brazil, Argentina, Bolivia, Paraguay, Peru
	<i>M. a. sarae</i> Thomas, 1925				Ecuador, Colombia, Venezuela, Trinidad, Guyana, Suriname, French Guiana, Brazil, Argentina, Bolivia, Paraguay, Peru
	<i>M. a. superciliaris</i> Gray, 1850				Ecuador, Colombia, Venezuela, Trinidad, Guyana, Suriname, French Guiana, Brazil, Argentina, Bolivia, Paraguay, Peru
	<i>M. a. whitelyi</i> Gray, 1873				Mexico, Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama
*Mazama americana (<i>temama</i> ssp. group)		red brocket	LR lc (DSG: DD)		Central America
*	<i>M. a. cerasina</i> Hollister, 1914			III (Guatemala)	
	<i>M. a. reperticia</i> Goldman, 1913				
	<i>M. a. temama</i> Kerr, 1792				Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
*Mazama bororo	<i>nomen nudum</i> , taxon as yet undescribed	greater red brocket	LR lc (DSG: DD)		southern Brazil
*Mazama chunyi	<i>M. c. chunyi</i> Herskovitz, 1959	Peruvian dwarf brocket	DD		Bolivia, Peru
*Mazama gouazoubira		brown brocket	LR lc (DSG: DD)		Ecuador, Colombia, Venezuela, Trinidad, Guyana, Surinam, French Guiana, Brazil, Argentina, Uruguay, Peru, Bolivia
*	<i>M. g. argentina</i> Lonnberg, 1919				
*	<i>M. g. cita</i> Osgood, 1912				
	<i>M. g. gouazoubira</i> Fischer, 1814				
*	<i>M. g. mexiana</i> Hagmann, 1908				Insular, Mexiana I.
*	<i>M. g. murelia</i> J.A. Allen, 1905				
*	<i>M. g. nemorivaga</i> F. Cuvier, 1817				
*	<i>M. g. permira</i> Kellogg, 1946				Insular, San Jose I., Panama, this sp. ?
*	<i>M. g. sanctaemartae</i> J.A. Allen, 1915				
*	<i>M. g. tschudii</i> Wagner, 1855				Argentina, Bolivia, Brazil, Colombia, Ecuador, Fr. Guiana, Guyana, Peru, Surinam, Trinidad, Uruguay, Venezuela
*Mazama nana	<i>M. n. nana</i> Hensel, 1872	Brazilian dwarf brocket	LR lc (DSG: DD)		Argentina, Brazil, Paraguay
*Mazama pandora	<i>M. p. pandora</i> Merriam, 1901	Yucatan brown brocket	LR lc (DSG: DD)		Yucatan peninsula, Mexico

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<i>Mazama rufina</i>		little red brocket	LR nt		Ecuador
	<i>M. r. bricenii</i> Thomas, 1898				Venezuela (given specific status by Grubb 1993)
	<i>M. r. rufina</i> Bourcier & Pucheran, 1852				
* Megamuntiacus vuquangensis	<i>M. v. vuquangensis</i> Schaller and Vrba, 1996	giant muntjac	DD	I	Cambodia, Laos, Vietnam (Annamite Mountains)
<i>Muntiacus atherodes</i>	<i>M. a. atherodes</i> Groves & Grubb, 1982	Bornean yellow muntjac	LR lc		Indonesia/Malaysia (Borneo)
<i>Muntiacus crinifrons</i>	<i>M. c. crinifrons</i> Sclater, 1885	black muntjac	VU (C1)	I	China (Zhejiang, Anhui)
* Muntiacus feae		Fea's muntjac	DD		China, Myanmar, Thailand., Laos
*	<i>M. f. feae</i> Thomas & Doria, 1889		DD		China, Myanmar, Thailand
*	<i>M. f. rooseveltorum</i> Osgood, 1932		DD		China (?), Laos
* Muntiacus gangshanensis		Gongshan muntjac	DD		China (Yunnan, Tibet), Myanmar, India (?)
<i>Muntiacus muntjak</i> (<i>muntjak</i> ssp. group)		red muntjac	LR lc		
	<i>M. m. montanus</i> Robinson & Kloss, 1918				Indonesia (Sumatran highlands)
	<i>M. m. muntjak</i> Zimmermann, 1780				Bangladesh, Bhutan, Cambodia, India, Indonesia/Malaysia (Malaya, Sumatra, Java, Borneo, Bali, Lombok, etc.), Laos, Nepal, Pakistan, S. China, Vietnam
<i>Muntiacus muntjak</i> (<i>vaginalis</i> ssp. group)		Indian muntjac	LR lc		
	<i>M. m. anamensis</i> Kloss, 1928				Cambodia (?), Laos, Thailand (?), Vietnam
	<i>M. m. aureus</i> Hamilton Smith, 1826				India, Myanmar, Pakistan
	<i>M. m. curvostylis</i> Gray, 1872				Myanmar, Thailand
	<i>M. m. malabaricus</i> Lydekker, 1915				India, Sri Lanka
	<i>M. m. menglalis</i> Wang & Groves, 1988				China (Yunnan), Laos, Myanmar, Vietnam
	<i>M. m. nigripes</i> G. Allen, 1930				China (Hainan)
	<i>M. m. vaginalis</i> Boddaert, 1785				India, Myanmar, Nepal
	<i>M. m. yunnanensis</i> Ma & Wang, 1988				China (Yunnan, Sichuan), Vietnam
<i>Muntiacus reevesi</i>		Reeves muntjac	LR lc		Introduced to Britain, France
	<i>M. r. micrurus</i> Sclater, 1875				Taiwan
	<i>M. r. reevesi</i> Ogilby, 1839				China (SE)
<i>Odocoileus hemionus</i> (<i>columbianus</i> ssp. group)		black-tailed deer	LR lc		Introduced to Hawaiian Islands
	<i>O. h. columbianus</i> Richardson, 1829				
	<i>O. h. sitkensis</i> Merriam, 1898				Canada, USA

Table 1 ... cont. List of Species and Subspecies of the Families Tragulidae, Moschidae, and Cervidae.

Species	Subspecies	Common name	1996 IUCN Red List ¹	CITES ²	Countries within range
<i>Odocoileus hemionus</i> (<i>hemionus</i> ssp. group)		mule deer	LR lc		Introduced to Argentina
	<i>O. h. californicus</i> Caton, 1876				
	<i>O. h. cerrosensis</i> Merriam, 1898	Cedros mule deer	EN (D1)		Insular, Cedros I., Mexico
	<i>O. h. crooki</i> , syn. <i>eremicus</i> (Mearns, 1897) Mearns, 1897				
	<i>O. h. fuliginatus</i> Cowan, 1933				
	<i>O. h. hemionus</i> Rafinesque, 1817				
	<i>O. h. inyoensis</i> Cowan, 1933				
	<i>O. h. peninsulae</i> Lydekker, 1898				
<i>O. h. sheldoni</i> Goldman, 1939				Insular, Tiburon I., Mexico	
<i>Odocoileus virginianus</i> (<i>cariacou</i> ssp. group)		Cariacú	LR lc		Northern South America and Central America
	<i>O. v. acapulcensis</i> Caton, 1877				
	<i>O. v. cariacou</i> Boddaert, 1784				Brazil, Colombia, Ecuador, Fr. Guiana, Guyana, Peru, Surinam, Venezuela; (reddish tropical races)
	<i>O. v. chiriquensis</i> J.A. Allen, 1910				
	<i>O. v. curassavicus</i> Hummelinck, 1940				Insular, Curacao
	<i>O. v. goudotii</i> , syn. <i>lesiotis</i> (Osgood, 1914), <i>consul</i> (Lönnerberg, 1922), & <i>ustus</i> (Trouessart, 1910) Gay & Gervais, 1846				
	<i>O. v. gymnotis</i> Wiegmann, 1833				
	<i>O. v. margaritae</i> Osgood, 1910				Insular, Margarita I., Venezuela
	<i>O. v. mexicanus</i> Gmelin, 1788				
	<i>O. v. miquihuanensis</i> & <i>O. v. veraecrucis</i> Goldman & Kellogg, 1940				
	<i>O. v. nelsoni</i> Merriam, 1896				
	<i>O. v. oaxadensis</i> Goldman & Kellogg, 1940				
	<i>O. v. peruviana</i> Gray, 1874				Colombia, Ecuador, Peru, Venezuela; (grey highland races)
	<i>O. v. rothschildi</i> Thomas, 1902				Insular, Coiba I., Panama. Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
	<i>O. v. sinaloae</i> J.A. Allen, 1903				
<i>O. v. thomasi</i> Merriam, 1898					

Table 1 ... cont. List of Species and Subspecies of the Families Tragulidae, Moschidae, and Cervidae.

Species	Subspecies	Common name	1996 IUCN Red List ¹	CITES ²	Countries within range
	<i>O. v. toltecus</i> Saussure, 1860				
	<i>O. v. tropicalis</i> Cabrera, 1918				
	<i>O. v. truei</i> Merriam, 1898				
	<i>O. v. yucatanensis</i> Hays, 1872				
<i>Odocoileus virginianus</i> (<i>virginianus</i> ssp. group)		white-tailed deer	LR lc		North America
	<i>O. v. borealis</i> Miller, 1900				
	<i>O. v. carminus</i> Goldmann & Kellogg, 1940				
*	<i>O. v. clavium</i> Barbour & G.M. Allen	Key deer or toy deer	EN (D1)		Florida Keys, USA
	<i>O. v. couesi</i> Coues & Yarrow, 1875				Mexico, United States; (transitional races)
	<i>O. v. dacotensis</i> Goldman & Kellogg, 1940				
*	<i>O. v. leucurus</i> Douglas, 1829	Columbian white-tailed deer	LR nt		Western Oregon & Washington State, USA
	<i>O. v. macrourus</i> Raginesque, 1817				
	<i>O. v. mcilhennyi</i> F.W. Miller, 1929				
	<i>O. v. ochrourus</i> V. Bailey				
	<i>O. v. osceola</i> Bangs, 1896				
	<i>O. v. seminolus</i> Goldman & Kellogg, 1940				All insular, off Georgia & S. Carolina, USA
	<i>O. v. taurinsulae</i> , <i>O. v. venatorius</i> , <i>O. v. hiltonensis</i> , & <i>O. v. nigribarbis</i>				Insular, Florida Keys. USA, Canada; (typical subspecies)
	<i>O. v. texanus</i> Mearns, 1898				
	<i>O. v. virginianus</i> Zimmermann, 1780				
	<i>O. v. leucurus</i>				
* <i>Ozotoceros bezoarticus</i>		Pampas deer	LR nt	I	Brazil, Paraguay, Uruguay
*	<i>O. b. bezoarticus</i> Linnaeus, 1758		LR nt		Brazil, Paraguay, Uruguay
*	<i>O. b. celer</i> Cabrera, 1943		EN (B1+2cde, C2a)		Argentina
*	<i>O. b. leucogaster</i> Goldfuss, 1817		LR nt		Argentina, Bolivia, Brazil, Paraguay
* <i>Pudu mephistophiles</i>	<i>P. m. mephistophiles</i> De Winton, 1896	northern pudu	LR nt	II	Colombia, Ecuador, Peru
* <i>Pudu puda</i>	<i>P. p. puda</i> Molina, 1782	southern pudu	VU (A1cde)	I	Chile, Argentina
<i>Rangifer tarandus</i> (<i>caribou</i> ssp. group)		woodland caribou or forest reindeer	LR lc		
	<i>R. t. caribou</i> Gmelin, 1788				Alaska, Canada, USA
	<i>R. t. dawsoni</i> Seton-Thompson, 1900				Insular, Graham I., Canada (extinct)
	<i>R. t. fennicus</i> Lönnerberg, 1909				China (Manchuria) (?), Finland, Mongolia, former USSR

Table 1 ... cont. List of Species and Subspecies of the Families Tragulidae, Moschidae, and Cervidae.

Species	Subspecies	Common name	1996 IUCN Red List ¹	CITES ²	Countries within range
<i>Rangifer tarandus</i> (<i>tarandus</i> ssp. group)		reindeer, barren-ground or tundra caribou	LR lc		
	<i>R. t. granti</i> J.A. Allen, 1902				Alaska
	<i>R. t. groenlandicus</i> Linnaeus, 1767				Canada, Greenland
	<i>R. t. tarandus</i> Linnaeus, 1758				Finland, Norway, former USSR
<i>Rangifer tarandus</i> (<i>platyrhynchus</i> ssp. group)			LR lc		
	<i>R. t. eogroenlandicus</i> Degerbol, 1956				Greenland
	* <i>R. t. pearyi</i> J.A. Allen, 1902	Peary caribou	EN (A1b, C1)		Canada (Queen Elizabeth Islands)
	<i>R. t. platyrhynchus</i> Vrolik, 1829				Svalbard
* Taxa shown in bold are those discussed in the Action Plan					
¹ DSG recommendation in brackets where applicable					
² Listings at species-level also apply to subspecies unless stated otherwise					

North America

Canada, Mexico, and United States

Synopsis

The modern day depletion of the cervid fauna in the Americas commenced during the 18th century in North America, following European settlement. Previously, the indigenous Indian population had minimal impact upon deer numbers. Westward human migration and settlement hastened the decline of a number of species, most notably elk (*Cervus elaphus*), whose numbers declined and whose range was rapidly reduced and fragmented by agriculture, sport hunting, and commercial harvesting for meat and hides. By the mid-1800s, many populations had declined dramatically, with two subspecies (*C. e. canadensis* and *C. e. merriami*) going extinct, and some, such as tule elk (*C. e. nannodes*) close to extinction.

During the 20th century, populations of most species stabilized and in some cases increased. White-tailed deer (*Odocoileus virginianus*) numbers, in particular, have risen dramatically, the population increasing from around 500,000 at the turn of the century to around 20 million today. This increase has been attributed to local eradication of predators and changing land use practices resulting in increasing secondary forest. Elk populations have recovered largely as a result of deliberate human action; either by reintroduction or by strict control of hunting. In the far north, caribou (*Rangifer tarandus*) have fared less well, its range declining in response to urban expansion, industrial development, and habitat loss due to logging.

Today, only four North American cervid subspecies are classified as threatened. Of these, the Peary caribou (*R. t. pearyi*) is confined to island habitats in the Canadian High Arctic and is presently declining rapidly and considered Endangered. Of the remaining three, the Key deer (*O. v. clavium*) is considered Endangered, the Columbian white-tailed deer (*O. v. leucurus*) as Lower Risk, and Cedros Island mule deer (*O. hemionus cerrosensis*) as Endangered. Their populations are either stable or increasing as a result of conservation efforts. The previously threatened tule elk (*C. e. nannodes*) has recovered from the brink of extinction due to conservation efforts dating back to the late 1860s, and is now considered safe. Initiatives to protect the Columbian white-tailed deer are more recent, and have focused

upon establishing the Columbia River Wildlife Refuge. Numbers have increased from a few hundred to 5,000 animals and the population is still increasing.

A number of conservation challenges remain. The most urgent is to reverse the present decline of Peary caribou, whose population has fallen by some 90% in the past three decades. A considerable amount of ecological research has been carried out on this subspecies and now a conservation strategy is urgently required. Support is also required for the Cedros Island mule deer in Mexico. While the population was thought to be stable during the mid-1980s, its small size and insular nature are likely to render it susceptible to hunting, predation by feral dogs, and environmental catastrophe.

Cedros Island mule deer *Odocoileus hemionus cerrosensis*

Cedros Island – Mexico

CITES: Not listed

1996 IUCN Red List Category: EN(D1)

Distribution and status in the wild

Endemic to Cedros Island, off Baja California. Until a 1980 survey was undertaken, it was believed by some observers to be extinct (Perez-Gil 1981). Population in 1985 estimated to be around 275 animals and stable (Povilitis and Ceballos 1986). In 1996, local reports and sightings indicated that the Cedros Island mule deer inhabit a small area of forest in which both locally owned and (perhaps) feral dogs hunt them (R. Marks, pers. comm. 1996).

- *Protected areas*: Cedros Island Wildlife Reserve.

Past distribution and status

No information.

Status in captivity

No information.

Ecology and reproduction

Habitat and food preference: Utilizes open desert scrub, chaparral, and closed cone pine forest (IUCN undated).

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: In the Cedros Island mule deer, breeding is between late October and mid-November. Most fawns are born in June following a gestation of 183–208 days (Whitehead 1993).

Uses

Subsistence: Occasionally hunted by local people for sport (IUCN undated; Povilitis and Ceballos 1986).

Commercial: None.

Causes of decline and present threats

Hunting pressure was reported to have increased between 1980 and 1985 (Povilitis and Ceballos 1986).

Field studies

Salas (1979); Povilitis and Ceballos (1986); Perez-Gil (1981).

Conservation action to date

Legally protected under Mexican law; all islands in area declared wildlife reserves in 1978. Ecological research program carried out in 1980 under aegis of WWF Project 1646 (Perez-Gil 1981).

Recommended conservation action

1. Status survey and monitoring to determine present population and trend. Activities should include field reconnaissance, standardized and repeated population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.
2. If subsistence hunting proves to be a serious threat, seek alternative subsistence schemes. Develop conservation education programs and increase law enforcement if necessary.

Reporter: Richard Marks.

Columbian white-tailed deer and Key deer *Odocoileus virginianus* ssp.

O. v. leucurus (Columbian white-tailed deer): Western Oregon and Washington, USA

O. v. clavium (Key deer or toy deer): Florida Keys, USA

CITES: Not listed

1996 IUCN Red List Category:

O. v. leucurus – LR(nt)

O. v. clavium – EN(D1)

Distribution and status in the wild

The Columbian white-tailed deer occurs as two separate populations in Oregon and Washington states; in Clatsop and Columbia Counties and along the lower Columbia River, Wahkiakum County, Washington; along the North Umpqua River Valley, Douglas County, Oregon. Altitudinal range is up to 200m. In Douglas County the population is estimated at 3,500–4,000; in the lower Columbia River area 800–1,000 (A. Clark, pers. comm. 1990). Both populations are now stable (DSG 1993).

- *Protected areas:* The Lower Columbia River population lies within the Julia Butler Hansen Wildlife Refuge. Protection is good and a management plan is in place which provides specifically for Columbian white-tailed deer conservation (USFWS 1983). The Douglas County population inhabits private land holdings.

The Key deer is presently restricted to the lower Florida Keys (islands) from Boca Chica to the Johnson Keys. Reported on 26 Keys between Spanish Harbor Bridge and Boca Chica (Klimstra *et al.* 1974; Klimstra, unpublished data). Some two thirds of the population occurs within the boundary of the National Key Deer Refuge on Big Pine Key. By 1950, the population may have been as low as 25 animals, however, following protection in 1957, populations increased and in 1974 some 200–250 were estimated on Big Pine Key and 100–150 on 22 other islands (Klimstra *et al.* 1974). In the early 1980s the population declined again to around 250–300 individuals (Hardin *et al.* 1984; Klimstra 1985).

- *Protected areas:* As above.

Past distribution and status

The Columbian white-tailed deer was abundant throughout southern Oregon along the Willamette River and its tributaries, south as far as the North Umpqua River drainage in Douglas County. It occurred along the Cowlitz River Valley and other tributaries of the Columbia River. Its distribution extended to the coast where it

probably ranged as far north as Puget Sound (USFWS 1983).

The Key deer possibly ranged from Key West to Duck Key and became endemic following a rise in sea level at the end of the Pleistocene (Hoffmeister and Multer 1968). Carrying capacity of the Keys region has probably always been low due to the scarcity of fresh water (Hardin *et al.* 1984).

Status in captivity

No information.

Ecology and reproduction

Habitat and food preference: The Columbian white-tailed deer inhabits islands and lowlands in the lower Columbia River flood-plain where habitats include open canopy forest and tall herb communities. In Douglas County, Oregon, it favors an oak woodland/grassland ecotone (Smith 1981). Diet: predominantly woody shrubs, herbs, and grasses (A. Clark, pers. comm.). The Key deer inhabits pinewoods, hardwood hammock, buttonwood, and scrub/mangrove habitats. Diet: woody shrubs, grasses, herbs, and fruit (Silvy 1975; IUCN undated).

Average group size and dispersion pattern: Columbian white-tailed deer: occurs in groups of up to three animals (Gavin *et al.* 1984; Smith 1981; Suring and Vohs 1979). Key deer: Females form loose matriarchal groups with one or

two generations of offspring. Bucks form groups outside the breeding season (Klimstra and Hardin 1978).

Movements: Columbian white-tailed deer: Washington population is generally sedentary. Douglas County animals utilize upland oak woodland/grassland areas during winter and spring, and move to wetter lowlands during the summer (Smith 1981; Gavin *et al.* 1984). Key deer: Seasonal movement influenced by the availability of fresh water.

Reproduction: Columbian white-tailed deer: Most births occur during early to mid-June (Smith 1981; Gavin *et al.* 1984). Key deer: Breeding occurs during September–October, with fawns born during April–May (Hardin 1974; Hardin *et al.* 1984). Reproductive rate is low. Age at first reproduction in males is usually three years (Hardin 1974).

Uses

Subsistence: None.

Commercial: None.

Causes of decline and present threats

Columbian white-tailed deer declined during the pioneer settlement period probably as a result of habitat conversion and over-exploitation (Gavin 1978). It was thought to be extinct by the 1930s (IUCN undated).



Key deer (*Odocoileus virginianus clavium*).

J. Dolan

Recovery has been sufficiently successful for a proposal to be made for down-listing from federal Endangered status (DSG 1993).

Key deer initially declined during the late 1800s probably due to intensive exploitation. Hunting continued into the 1950s despite state legislation. The 1980s decline was probably due to poaching. Present threats are habitat loss due to development, reduction of surface fresh water due to ground water extraction (particularly on Big Pine Key), road kills, and predation by domestic dogs. There is a high fawn mortality (many drown in ditches) (Hardin 1974). The small population is considered susceptible to catastrophic environmental events such as hurricanes, to which the region is prone (Seal and Lacy 1990).

Field studies

Columbian white-tailed deer: A. Clark (fawn mortality); S. Denney (parasitism and disease).

Key deer: Dickson, 1955; Dooley, 1975 (food habits); Hardin, 1974 (behavior, sociobiology and reproductive life history); Hardin *et al.*, 1984 (population dynamics and habitat requirements).

Conservation action to date

Columbian white-tailed deer: conservation initiatives taken in 1975 included: acquisition and development of Wildlife Refuge in the Columbia River area; extensive ecological research into habitat requirements; and habitat management activities including limited livestock grazing to enhance pasture habitat (IUCN, undated). Recovery plan was revised in 1983 (USFWS 1983).

Key deer: Florida legislature banned hunting of Key deer in 1939 but this was not enforced. Protected area established in 1957. The Key deer was placed on the federal list of endangered species (1967) and listed as Threatened by Florida State in 1973. Ecological studies were initiated in 1964 by U.S. Fish and Wildlife Service and a recovery plan was produced in 1985 (USFWS, 1985). Central issues include habitat acquisition, monitoring of deer populations and habitat, habitat manipulation, and public education. Implemented recommendations include controlled burning to improve habitat quality, enhancement of surface water supply, and ditch filling (to reduce fawn mortality). Efforts have been made to enlarge the protected area.

Recommended conservation action

Columbian white-tailed deer:

1. Continue monitoring and research program.

2. Enlarge Julia Butler Hansen Wildlife Refuge.

Key deer: Ensure continued implementation of recovery plan including the following:

1. Extend protected area on Big Pine Key and place major emphasis on conservation of remaining wetland areas.
2. Manage local development through land use planning legislation.
3. Improve surface freshwater availability in selected areas.
4. Continue research program to determine status and trend of populations.
5. PVA (Seal and Lacy 1990) recommends establishing a captive population primarily to protect from environmental catastrophe.

Reporter: Alan C. Clark (Washington State, USA).

Peary caribou *Rangifer tarandus pearyi*

Queen Elizabeth Islands, Canada

CITES: Not listed

1996 IUCN Red List Category: EN(A1b, C1)

Distribution and status in the wild

Occurs only on the Queen Elizabeth Islands in the Canadian High Arctic (Northwest Territories) up to 900m (Meldgaard 1986; Roby *et al.* 1984). Population currently estimated at 3,300–3,600, a decrease of some 90% in the past 30 years (Miller 1990).

- *Protected areas:* None.

Past distribution and status

Canadian Arctic Archipelago, and possibly northern Greenland (Miller 1990).

Status in captivity

Probably none (F. Miller, pers. comm. 1990).

Ecology and reproduction

Habitat and food preference: Utilizes poorly to moderately vegetated xeric to mesic habitats where herbs, grasses, sedges, and foliose lichens are important forage. Crustose lichens may be taken when snow conditions hinder foraging on better sites (Miller 1990).



Male caribou (*Rangifer tarandus*), Denali National Park, Alaska, USA. Caribou and reindeer are widely distributed throughout the north circumpolar regions. The species has various subspecies of which the Peary caribou (*R. t. pearyi*) is Endangered.

WWF/Eric Dragesco

Average group size and dispersion pattern: In winter, groups of up to five with a high proportion of solitary animals and pairs; in summer, larger groups of five to ten form during the post-calving period (July–August). Group size is strongly influenced by overall density (Miller 1990).

Movements: Frequent inter-island movements and seasonal migrations; particularly to small islands in spring for calving (F. Miller, pers. comm.).

Reproduction: Duration of calving period is poorly documented but probably takes place in mid- to late June, which is later than for other caribou (Miller 1990). Gestation in the Peary caribou is 7.5 to 8 months (Whitehead 1993).

Uses

Subsistence: In the past, hunted by local Inuit for food, clothing, and other products (Miller 1990).

Commercial uses: Skins and antlers are used by Inuit for manufacturing products for the tourist trade (Miller 1990).

Causes of decline and present threats

Probably unfavorable winter conditions and natural population fluctuations (Miller 1990).

Field studies

Interaction with musk oxen; foraging behavior; seasonal movements; nursing behavior; mortality (see Miller 1990).

Conservation action to date

Currently recognized as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). There is no management or recovery plan at present.

Recommended conservation action

A recovery plan is urgently required (Miller, 1990).

Reporter: Frank L. Miller.

South and Central America

Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, French Guyana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Surinam, Trinidad, Uruguay, Venezuela

Synopsis

Intensive exploitation of South American cervids followed European settlement of the continent and probably focused initially on the accessible Pampas grasslands and range lands of Chile and Argentina. Pampas deer (*Ozotoceros bezoarticus*), for example, were hunted intensively during the 19th century and their hides were processed on a vast scale; over two million were exported between 1860 and 1870.

During the latter half of the 20th century, road construction allowed human settlement to encroach into the interior of the continent. Habitat conversion for agricultural and industrial activities have affected large tracts of forest and wetland, resulting in the fragmentation, isolation, and depletion of previously abundant species populations, such as marsh deer (*Blastocerus dichotomus*). A number of upland species are also reported to be declining. The ranges of huemul (*Hippocamelus bisulcus*) and southern pudu (*Pudu puda*) have contracted, and populations declined as a result of cattle ranching, logging, and poaching. Hunting and competition with domestic livestock and exotic deer have resulted in declines in huemul populations. Furthermore, local people do not distinguish between abundant exotic deer in the southern part of the continent and scarce native deer, and thus have the impression that deer are abundant.

Threatened cervids occur in at least 22 countries throughout South and Central America. Of these, Paraguay, Peru, and Bolivia are in most urgent need of institutional and fiscal support, based on the number of taxa and status of existing programs. Argentina has the greatest number of taxa (eight), of which two, the Pampas deer (*O. b. celer*) and huemul have Endangered status. All South American countries with native deer populations should be supported in order to preserve large natural areas harboring intact communities of wildlife. Furthermore, conservation initiatives for large flagship species, such as endemic deer, will require incentives, encouragement, and financing. “Reservas privadas” and other public-private partnerships are essential to the conservation of these species and native landscapes.

A number of conservation initiatives are already underway. The Pampas deer (*O. b. celer*) has been the subject of an extensive ecological study and has benefited

from both private and state funded conservation measures. These measures have included the establishment of protected areas and a captive breeding program, but require further institutional support and research funding. Since the remaining ranges of southern deer species lie for the most part on private land, new approaches to conservation must be proactively pursued by the government and conservation NGOs. Tax incentives and conservation easements are viable options deserving careful consideration, and the supporting role of environmental education should go hand-in-hand with these measures. There is a significant need for education regarding the environment and its wildlife legacy, particularly to inform human populations about the difference between introduced (exotic) and endemic deer. Brazil and Paraguay both support populations of Pampas deer *O. b. bezoarticus* (Vulnerable) and *O. b. leucogaster* (Lower Risk, near threatened), as well as marsh deer (Vulnerable). Recent surveys in the pantanal wetlands of southwestern Brazil have revealed some 36,000 marsh deer, far more than were thought to be present a decade ago. Conservation efforts should concentrate on this population as the integrity of the wetland is threatened by a range of human activities, including the Hydrovia development project. These efforts should be addressed within the context of an integrated conservation and development plan for the region, which will require developing partnerships with development and conservation agencies. In Chile, the most pressing concerns are huemul (Endangered), taruca or northern huemul (*H. antisensis*) (Data Deficient), and southern pudu (Vulnerable), all of which face threats from cattle ranching, competition with exotic deer, and destruction of native forest from fire and logging. Conservation initiatives for huemul have included replanting native tree species around protected areas, and there are plans to purchase additional land for this purpose. Protected areas management requires strengthening and the network of protected areas requires enlargement. In Uruguay, the marsh deer (Vulnerable) is now known to be present, having previously been reported as extinct, with perhaps a few groups of deer living on private land holdings. These populations are in need of additional support to ensure their long-term viability. Options such as ecotourism or deer farming should be explored in conjunction with landowners. The acquisition of land for protected area

designation should also be considered. Private reserves will be indispensable in this part of South America.

In other countries throughout the region, the status of virtually all native deer should be determined. Threats to species such as northern pudu (*Pudu mephistophiles*) and to all seven species of brockets are almost certainly increasing, and the extent of the threats and their impacts upon populations should be ascertained before conservation measures are prescribed. The three species of dwarf Andean brockets (*Mazama chunyi*, *M. nana*, and *M. rufina*) merit particularly close attention in order to determine their distribution and viability as populations.

Marsh deer *Blastocerus dichotomus*

Argentina, Bolivia, Brazil, Paraguay, Peru, Uruguay

CITES: I

1996 IUCN Red List Category: VU(A2c,d,e)

Distribution and status in the wild

Occurs in seasonally inundated grasslands of south-central South America; in northeastern Argentina, west-central and southern Brazil, Paraguay, Uruguay, southeastern Peru, and eastern Bolivia (Hofmann *et al.* 1976; A. Gardner, pers. comm.). The species is declining throughout much of its range (Nowak and Paradiso 1983) although recent surveys in Brazil have revealed higher populations than had been previously recorded (de Arruda Mauro 1993).

Argentina: Occurs in northeastern Argentina, south to the Paraná Delta, some 80km north of Buenos Aires (Jungius 1974,1976). Country-wide population estimated at less than 2,000 animals.

Chaco Province: Occurs in places along the Bermejo River.

Formosa Province: Confined to a few isolated marshes on southern ranches, flood-plains of the Pilcomayo River, and nearby marshes.

Corrientes Province: Marshes of Bate and Batelito, Esteros del Iberá, and along the Paraná River. Also present in the Batel, Batelito, Maloyas, and Santa Lucia marshes (Beccaceci 1994).

Entre Ríos and Buenos Aires provinces: Populations primarily in the extensive marshes along the Rio Paraná in the Paraná Delta (Schaller and Tarak 1976), as well as the Uruguay River. Populations are generally small and scattered; the species occurs at low density and was reported to be under serious pressure throughout its range in Argentina in the 1970s (Schaller and Tarak 1976). Total population estimated at less than 1500 animals in 1990 (M.D. Beccaceci, pers. comm. 1990).

- *Protected areas:* Rio Pilcomayo National Park; Isla del Cerrito Provincial Nature Reserve (WCMC 1992); Ibera Natural Reserve (1,200,000ha) population reported at 1100 and possibly increasing (Beccaceci 1994).

Bolivia: In the mid-1970s it occurred in eastern Bolivia in humid grasslands and forest edge habitat, from the foot of the Andes between Punto Heath and Santa Cruz, southeast as far as the Brazilian border (Jungius 1974, 1976). Numbers are said to have declined considerably in recent decades, and populations exist only in isolated areas with difficult



Marsh deer,
Blastocerus dichotomus.

M. Gimenez-Dixon

access and on some private land holdings (Mann and Schuerholz 1977).

- *Protected areas:* Ialboro National Park and Beni Biological Station (WCMC 1992). Territorio Indígena Parque Nacional Isiboro-Sécure, Parque Nacional Amboró, Reserva Nacional Manripi-Heath, Parque Nacional Noel Kempoff, and Reserva Nacional Lagunas de Beni y Pando (T. Tarifa, pers. comm. 1994).

Brazil: Information gathered at a PHVA workshop indicates that approximately 41,000 marsh deer still survive in Brazil (Pinder 1995). Main population occurs in the Pantanal (Mato Grosso swamps) of west-central Brazil, where numbers were estimated at approximately 36,000 following an aerial survey (de Arruda Mauro 1993). Important populations probably still occur in the Araguaia, Xingu, and Guapore basins, but no surveys have been carried out to assess numbers (L. Pinder, pers. comm. 1994). A 1992 survey of the Paraná River basin along most of the border with São Paulo and Mato Grosso do Sul states revealed a population of 700–1,200 marsh deer. Some 1,200 probably occupy the remaining flood-plains to the south as far as the Itaipu hydroelectric dam on the border with Argentina, where a relict population of 25 animals is reported to remain on the margins of the lake upstream of the dam (L. Pinder, pers. comm. 1994). Around 120 animals are reported along the Rio do Pantano, a tributary of the Paraná.

- *Protected areas:* Cara Cara and Taim e Taiama reserves and Grande Sertao Veredas National Park (L. Pinder, pers. comm. 1994).

Paraguay: Principal population is in the Yacyretá region where density is low. The majority of this population is under threat from the Yacyretá hydroelectric project (S. Yubero, pers. comm.). An unsuccessful attempt was made to rescue some of the animals during inundation. Most populations in Paraguay were reported to be declining in the 1970s (Jungius 1974, 1976).

- *Protected areas:* Tinfunque and Ypacaral National Parks (WCMC 1992).

Peru: Occurred in Pampas del Heath during the mid-1970s (Hofmann *et al.* 1976), and estimated to number about 40 in 1982 (C.F. Ascorra, pers. comm. 1994). Now considered extinct (Pinder 1995).

- *Protected areas:* No information.

Uruguay: Previously believed to be extinct. Until recently, the last reported occurrence was from Rocha, Bañados Los Indios Arredondo in 1959. In 1991 an adult female was captured in the Villa Soriano region (S. Gonzalez, pers. comm. 1994). Now considered extinct (Pinder 1995).

- *Protected areas:* Possibly still existed in 1981 in Santa Teresa National Park and Bañados del Este (WCMC

1992; D. Muller-Schwarze and I. Verdier, pers. comm.). Current status is critical if not extinct.

Past distribution and status

Originally much more widely distributed throughout present range (Nowak and Paradiso 1983). The species was reported as common in Bolivia until recent decades (Mann and Schuerholz 1977).

Status in captivity

Table 2. Status of *Blastocerus dichotomus* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
Brazil	Itaipu Dam	?	16	Promissao*

* Breeding facility was established by the owners of the Itaipu hydroelectric dam using animals captured from the populations near the Tiête River when the valley was flooded in 1990 (L. Pinder, pers. comm. 1994).

Ecology and reproduction

Habitat and food preference: Utilizes wet savanna and forest edge habitat. Diet is generally grasses, reeds and aquatic plants, but may include shrubs and vines during prolonged flooding (Nowak and Paradiso 1983).

Average group size and dispersion pattern: Solitary or in small groups of 2–3. Aggregations of up to six animals have been reported on islands during floods (Schaller and Vasconcelos 1978).

Movements: Seasonal movement between marshes and raised areas in response to changing water levels (Mann and Schuerholz 1977).

Reproduction: Single calf during May–September, following a nine-month gestation (Nowak and Paradiso 1983).

Uses

Subsistence: Hunted for food and sport throughout range. Hides are a popular work-cloth among gauchos in Argentina (M.D. Beccaceci, pers. comm.). In Bolivia, the species forms the principal source of meat for ranch laborers (Mann and Schuerholz 1977).

Commercial: In Argentina, heads and antlers are sold as trophies (M.D. Beccaceci, pers. comm.), but this is not an

intense commercial activity (M. Gimenez-Dixon, pers. comm. 1994).

Causes of decline and present threats

The species is declining throughout its range due to excessive hunting and wetland conversion for agriculture. In Brazil, hydroelectric projects have eliminated floodplain habitat along many large rivers, including the Tiete, Paraná, and Rio Grande (DSG 1991), and cattle ranching has severely reduced and fragmented habitats. The Paraná-Paraguay multinational waterway project could impact populations of the Pantanal and the many rivers of the de la Plata basin (M. Beccaceci, pers. comm. 1994). Competition with domestic livestock may be an important factor (Schaller and Vasconcelos 1978) and pollution of waterways associated with gold mining is a serious threat in the Pantanal. Accidental introduction of bovine diseases may account for large losses reported in Bolivia during the 1970s when reproductive failure was reportedly common (Mann and Schuerholz 1977). Beccaceci (1994) also mentioned disease, hunting, and competition with livestock as possible limiting factors in the Ibera Natural Reserve, Argentina. Behavior during the rut and the species' dietary habits have caused some conflict with the fruit and forestry industries in some areas, particularly the Paraná Delta (M. Gimenez-Dixon, pers. comm. 1994).

Field studies

Argentina: M.D. Beccaceci (in Ibera Natural Preserve).

Brazil: W. Tomas (Pantanal population); L. Pinder (on Pantanal population: community structure and competition between feral, domestic, and native ungulates; ranging behavior; census); R. de Arruda Mauro (aerial survey of the Pantanal during 1992).

Conservation action to date

In Argentina, a reintroduction project was initiated in Río Pilcomayo National Park in 1994 (M. Beccaceci, pers. comm. 1994). In 1990, over 100 animals were translocated following construction of a hydroelectric scheme on the Tiete River, Brazil (DSG 1991). Approximately 16 of these are currently held in a captive breeding facility established at Promissão, Brazil by the owners of the Itaipu hydroelectric dam (L. Pinder, pers. comm. 1994). A conservation program was drafted by the Companhia Energética de São Paulo (CESP 1993).

In Bolivia, a WWF project was initiated in 1977 to investigate the feasibility of establishing a protected area

in the Lake Rogoguardo region. The project was halted due to human settlement of the area.

A Population and Habitat Viability Assessment (PHVA) workshop was organized by Companhia Energética de São Paulo in August 1994 (Pinder 1995).

Recommended conservation action

1. Identify suitable areas of habitat and determine status throughout region. Initiate regular monitoring program to determine trends.
2. Strengthen existing protected areas management. Many protected areas are without management plans and most do not receive sufficient resources to provide adequate protection. Develop community based management strategies in response to human encroachment. Exclude livestock from protected areas with physical barriers and law enforcement; reduce numbers of livestock; improve livestock management through farmer education demonstration projects.
3. Hunting: management strategies should be developed to regulate the currently high level of hunting. Trophy hunting and commercial exploitation of the species must be strictly controlled. Investigate possibility of establishing deer farms.
4. Encourage appropriate husbandry and cooperative breeding programs for animals already in captivity.
5. Enlist cooperation of local landowners in maintaining the species, possibly in conjunction with ecotourism programs and other incentives.
6. Determine role of disease in limiting population size.

Reporters: Marcelo D. Beccaceci (Argentina), Laurenz Pinder (Brazil), Teresa Tarifa (Bolivia), Wilfrido Sosa Yubero (Paraguay), S. Gonzalez (Uruguay).

Taruca, northern huemul or north Andean deer *Hippocamelus antisensis*

Argentina, Bolivia, Chile, Ecuador (extinct), Peru

CITES: I

1996 IUCN Red List Category: DD

Distribution and status in the wild

Confined to mountainous terrain along the Central and Eastern Cordilleras of the northern Andes. Occurs between 3,000 and 5,200m, in the border region of northern Argentina, southern Peru, northern Chile, the eastern

Cordillera of Bolivia (Pearson 1951; Jungius 1976), and possibly as far north as Ecuador.

Argentina: Northern Argentina and the pre-Andean ranges north of La Rioja (Jungius 1976; Cajal 1983). Total numbers unknown, but thought to be declining in some areas (M.D. Beccaceci, pers. comm. 1991).

- *Protected areas:* Calilegua National Park.

Bolivia: Isolated populations reported during the 1970s throughout the eastern Cordillera; north of La Paz and the Pelechuco Altura de Araca and Cochabamba regions (Jungius 1974, 1976).

- *Protected areas:* Ulla Ulla Faunal Reserve; possibly in Parque Nacional Sajama.

Chile: Occurs outside Lauca National Park at lower elevations. Have been seen grazing in human-cultivated alfalfa fields (J. Jimenez, pers. comm.).

- *Protected areas:* Lauca National Park.

Peru: Widespread at low density in Peru (J.R. Merkt, pers. comm. 1990).

- *Protected areas:* Huascarán and Manu National Parks, Pampa Galeras National Reserve and Centro Nacional de Camelidos (La Raya). Protection is not adequate and there are no management plans (J.R. Merkt, pers. comm. 1990). Also in Rio Abiseo National Park and Salinas y Aguada Blanca National Reserve (C.F. Ascorra, pers. comm. 1994).

Ecuador: Probably extinct (J.R. Merkt, pers. comm.).

- *Protected areas:* No information.

Past distribution and status

Northern Andes, from Ecuador south through Bolivia, northeastern Chile and northwestern Argentina as far south as Province Catamarca (IUCN 1976) and La Rioja (M. Gimenez-Dixon, pers. comm. 1994).

Status in captivity

No information.

Ecology and reproduction

Habitat and food preference: Sub-alpine meadows and tundra habitats above the tree line, in rocky terrain (J.R. Merkt, pers. comm.). In Argentina, inhabits rocky grasslands and wet montane forest fringes. Feeds on grasses and herbs (J.R. Merkt, pers. comm.) and occasionally woody shrubs (M.D. Beccaceci, pers. comm.). In Chile, visits alfalfa fields.

Average group size and dispersion pattern: Generally social except fawning season; in southern Peru forms mixed or single sex aggregations averaging 6.4 animals (Merkt 1987).



Taruca, northern huemul or north Andean deer (*Hippocamelus antisensis*) (male), Peruvian Andes.

WWF-Canon/Hartmut Jungius

Movements: Individuals maintain year-round home ranges. There is a marked daily altitudinal movement between valley bottoms and ridges (Merkt 1987).

Reproduction: Rut occurs in June and calving between February and April, following a nine month gestation (Merkt 1987).

Uses

Subsistence: In Peru, hunted occasionally for meat (J.R. Merkt, pers. comm.).

Commercial: No information.

Causes of decline and present threats

Threats include competition with domestic stock, habitat destruction, trophy hunting, and predation by domestic dogs (Miller *et al.* 1973; J.R. Merkt, pers. comm.). In Bolivia, antlers are used in traditional medicine to cure facial paralysis (T. Tarifa, pers. comm.) and dried meat is used by rural populations (CDC 1987). Have been seen grazing in alfalfa fields and thus are subject to shooting (J. Jimenez, pers. comm.).

Field studies

J.L. Cajal (Status survey in Argentina); Merkt (1987) (feeding ecology and habitat use in southern Peru); Roe and Rees (1976) (Peru).

Luis Paz-Soldan (pers. comm. 1994) reported his intention to evaluate the status of the population in Rio Abiceo National Park, and to investigate feeding ecology.

Conservation action to date

No information.

Recommended conservation action

1. Systematic surveys urgently required to determine status and extent of geographic distribution. Support continued ecological studies of the species throughout its range.
2. Strengthen protected areas management. Many areas are without management plans and adequate resources, and often suffer poaching and encroachment due to isolation and limited staff and equipment.

3. Exclude domestic stock from protected areas with physical barriers and law enforcement; reduce numbers of livestock; improve livestock management through farmer education demonstration projects.

Reporters: Juan R. Merkt and Albert W. Franzmann.

Huemul or south Andean deer *Hippocamelus bisulcus*

Argentina, Chile

CITES: I

1996 IUCN Red List Category: EN(C2a)

Distribution and status in the wild

Occurs in fragmented populations, between 200–3,000m in the southern Andes; from Mendoza, Argentina, to the Straits of Magellan, Chile (G. Stutzin, pers. comm.). Thought to total fewer than 1,000 animals and decreasing (A. Povilitis, pers. comm. 1990). Typically occurs at low density of around two animals per km² (A. Povilitis, pers. comm.).

Argentina: Occurs as small scattered and isolated populations along the Andean foothills from southwestern Santa Cruz Province in the south to southwestern Neuquen Province in the north. Known to occur at Chubut (Lago de la Plata and Frontera) and Santa Cruz (Parque Nacional Perito Moreno) (A. Povilitis, pers. comm. 1990) where the total population is reported to number “a few hundred” animals (M.D. Beccaceci, pers. comm. 1991).

• *Protected areas:* Reported from Los Arayanes, Lago Puelo, Los Alerces, Los Glaciares, Nahuel Huapi, and Tierra del Fuego National Parks (WCMC 1992) and possibly Rio Carrera Provincial Park (A. Serret, pers. comm.). The species has been protected “on paper” since 1929.

Chile: Highly threatened small population in Nevados de Chillán area (30–60 animals) (A. Povilitis, pers. comm. 1990) and scattered populations further south. Possibly occurs on islands in the Rio Claro, Aysen area (G. Stutzin, pers. comm.; Frid 1994). It has been estimated that no more than 1,000 animals survive in Chile (Anon. 1994).

• *Protected areas:* Reported to occur in Ñuble, Rio Simpson and Cerro Castillo Nature Reserves and Tamango Forest Reserve (G. Stutzin pers. comm.; A. Povilitis, pers. comm.). According to Simonetta (1995), the species is protected in 13 Chilean national parks and reserves. Protection is not considered adequate due to small size of reserves and inadequate coverage of protected areas network (A. Povilitis, pers. comm.). There are no management plans.

Past distribution and status

Formerly more widespread; along the foothills of the southern Andes in Chile and Argentina, from Santiago Province in Chile, south as far as the Strait of Magellan, where it was present on a number of islands (IUCN 1976). Reported to occupy about 50% of its former range in Chile (Anon. 1994).

Status in captivity

None; recent efforts have failed to maintain the species in captivity (A. Povilitis, pers. comm. 1990).

Ecology and reproduction

Habitat and food preference: Specialized for broken terrain in humid montane forests (Valdivian type) (Povilitis 1978; M.D. Beccaceci, pers. comm.). The summer diet of huemul at Los Glaciares National Park includes grasses, forbs, and woody browse from trees and shrubs (M. Merino 1993).

Average group size and dispersion pattern: Solitary, or in small groups of up to three animals. Males and females associate throughout the year (A. Serret, pers. comm.; A. Povilitis, pers. comm.).

Movements: Both sedentary and migratory groups have been documented. Migratory groups move to lower elevations in the winter (A. Povilitis, pers. comm.).

Reproduction: Most births between November and December (M.D. Beccaceci, pers. comm.). Gestation period is 7.5 to 8 months (Whitehead 1993).

Uses

Subsistence: Hunted by indigenous people for a variety of purposes (A. Povilitis, pers. comm.).

Commercial: Possibly trapped for the illegal zoo trade (A. Povilitis, pers. comm.).

Causes of decline and present threats

Primarily due to habitat conversion for cattle grazing and logging. Competition with domestic livestock (cattle and goats) and exotic deer, hunting, and predation by domestic dogs are serious additional threats (Povilitis 1978; G. Stutzin, pers. comm.; Anon. 1994). The species is highly susceptible to bovine disease (E.J. Ramilo, pers. comm.),

and Simonetta (1995) reports it is susceptible to the parasite *Cysticercus tenuicollis*, which when transmitted by livestock is fatal. Threats are compounded by the small size and isolated nature of populations (A. Povilitis, pers. comm. 1990; Anon. 1994).

Field studies

A. Serret (status surveys carried out under aegis of Proyecto Huemul, Argentina); A. Povilitis (Povilitis 1978, 1983, 1985); D. Aldridge (food habits and behavior in Tamango Forest Reserve, Chile); and Frid (1994) in Chile.

Conservation action to date

The species has provided a focus for conservation efforts in Chile and Argentina due to its aesthetic and symbolic value. Proyecto Huemul was initiated in 1986 by the Argentinean Wildlife Foundation to conduct ecological and status surveys. A native tree replanting scheme has been initiated in areas of former grazing around the Rio Simpson reserve (D. Muller-Schwarze, pers. comm.).

A proposal to re-establish the huemul in Torres del Paine National Park, Chile, was unsuccessful in 1989 (CONAF 1989), as was an attempt to introduce four animals to Isla Dawson (Anon. 1994).

Raleigh International (U.K.) agreed to undertake censuses of huemul in Chile following discussions with CONAF, and two surveys in two reserves were completed in 1996 (Gill 1996).

Recommended conservation action

1. Special efforts should be made to conserve the few remaining northern populations which may constitute a separate subspecies (A. Povilitis, pers. comm. 1990).
2. Strengthen and support existing protected areas management and enlarge reserves where possible. Expansion will necessitate purchase and restoration of adjacent land. Habitat degradation by encroaching livestock should be addressed within context of community-based management plans and environmental education of livestock owners. Methods of controlling or utilizing exotic deer should be investigated.
3. Support and expand existing ecological research programs to provide baseline data on which to base a coordinated management strategy for the species throughout its range. Status of all existing populations should be determined and trends monitored.
4. Establish cooperative captive breeding program if appropriate.

Reporters: Eduardo J. Ramilo (Argentina), Alejandro Serret (Argentina), Albert W. Franzmann (USA), Robin Gill (U.K.), Dietland Muller-Schwarze (USA), Godofredo Stutzin (Chile), Anthony Povilitis (USA), M. Merino (Argentina), R.P. Schlatter (Chile).

Red brocket deer *Mazama americana*

M. a. americana, *M. a. carrikeri*, *M. a. gualea*, *M. a. trinitatis*, *M. a. zamora*: Ecuador, Trinidad

M. a. jucunda, *M. a. sheila*, *M. a. zetta*, *M. a. rosii*, *M. a. toba*, *M. a. sarae*, *M. a. superciliaris*: Ecuador, Colombia, Venezuela, Trinidad, Guyana, Surinam, French Guiana, Brazil, Argentina, Bolivia, Paraguay, Peru

M. a. whitelyi, *M. a. temama*, *M. a. cerasina*, *M. a. pandora*, *M. a. repticia*: Mexico, Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica, Panama

CITES: *M. a. cerasina* – III (Guatemala)

1996 IUCN Red List: LR(lc); DD (DSG recommended)

Distribution and status in the wild

The red brocket deer occurs in Trinidad and in all Central and South American countries except Chile (Nowak and Paradiso 1983). Status of most subspecies is unknown. Known distribution by country is:

Argentina: Occurs in Misiones, north of Formosa, Chaco, and Corrientes; east of Jujuy, and in Salta and Tucumán provinces.

- **Protected areas:** Pilcomayo National Park (Formosa Province), Iquazú National Park (Misiones Province), El Rey National Park (Salta Province), Baritú National Park (Salta Province), and Calilegua National Park (Jujuy Province) (M. Merino, pers. comm. 1994).

Bolivia: Occurs in Departments Beni, Cochabamba, La Paz, Pando, Santa Cruz, and Tarija (Anderson 1993).

- **Protected areas:** Territorio Indígena Parque Nacional Isiboro-Sécure, Parque Nacional Amboró, Reserva de la Biósfera Estación Biológica Beni, Reserva Nacional Manuripi-Heath, Parque Nacional Noel Kempff Mercado.

Costa Rica: Locally abundant up to 3,000m (R. La Val, pers. comm.)

- **Protected areas:** Occurs in most protected areas (R. La Val, pers. comm.) including Braulio Carrillo, Chirripo, Corcovado, Volcán Irazú, and Volcán Poas National Parks, Monteverde Cloud Forest Biological Reserve, and Rafael Lucas National Wildlife Refuge (WCMC 1992).

Paraguay: *M. a. jucunda* probably reduced to fragmented populations scattered throughout intact rain forest in the Oriental region. Although geographically restricted, is probably not yet threatened by human activity (D. Brooks, pers. comm.).

- **Protected areas:** Reported from Cerro Cora, Teniente Enolsoo and Ybycui National Parks (WCMC 1992).

Peru: Occurs throughout the Amazonian region to approximately 2,000m. The red brocket deer has been overhunted in densely human populated, rural areas, but still occurs at natural densities in the vast sparsely populated areas of the Peruvian Amazon.

- **Protected areas:** The protected areas that have significant populations of red brocket deer in the Peruvian Amazon include Pacaya-Samiria National Reserve, Manu National Park, Tambopata-Candamo Reserve Zone, and Tamshiyacu-Tahuayo Community Reserve.

Venezuela: Widespread at low density in northern and northwestern Venezuela up to 2,000m (J.R. Dietrich, pers. comm.).

- **Protected areas:** Occurs in most protected areas including Aguaro-Guariquito, Cerro El Copey, El Guácharo, Henri Pitier, Macaro, Morrooy, Terepalma, Yaoumbu, and Yurubi National Parks, and María Llonza Natural Monument (WCMC 1992).

Past distribution and status

No information.

Red brocket deer (*Mazama americana*) in ZooMat Tuxtla Gutierrez, Chiapas, Mexico.



WWF-Canon/Tony Rath

Status in captivity

In Venezuela, single individuals have been kept in the Caricuao Zoo, Caracas and births have been recorded at Barquisimeto Zoo. For internationally held stock see ISIS (1993).

Ecology and reproduction

Habitat and food preference: In the rain forests, red brocket deer are predominantly frugivores with fruit making up around 80% of their diet. During seasonally dry periods the diet of *M. americana* switches to greater proportions of browse. Red brocket deer prefer the moist to dryer habitats and generally avoid the wetter flooded habitats.

Average group size and dispersion pattern: Have occasionally been seen in pairs. One radio-collared male in the Peruvian Amazon had a home range size of 1km² (Bodmer, unpublished data).

Movements: No information.

Reproduction: In Surinam, calving was thought to be from September–April (although may be year-round) (Branan and Marchinton 1987) following a gestation of about eight months (Whitehead 1993). Age at first reproduction may be as early as 11 months (Branan and Marchinton 1987) and females show post-partum estrus, allowing pregnancy to occur shortly after birth and during lactation (Gardner 1971). In western Amazonia, *M. americana* reproduce throughout the year without any significant seasonal differences (Bodmer, unpublished data).

Uses

Subsistence: Hunted for meat throughout much of its range (J.R. Dietrich, pers. comm.). Subsistence hunting of red brocket deer is legal in the Amazonian region of Peru.

Commercial: There has been insignificant traffic in the pelts of red brocket deer even though its pelt is listed as being legally exported from Peru. The meat of red brocket deer is sold extensively in the markets of larger cities throughout the Amazon basin such as Iquitos. In the Peruvian Amazon, hunters currently receive about US\$30 for the meat of one adult.

Causes of decline and present threats

Costa Rica: Hunting and habitat destruction (J.R. Dietrich, pers. comm.).

Paraguay: Habitat destruction (Brooks, undated).

Venezuela: Habitat destruction and illegal hunting, especially in the vicinity of settlements and roads (J.R. Dietrich, pers. comm.).

Field studies

F. Leeuwenburg and L. Resende; R. Bodmer (in Peru) (1988, 1989a, 1989b, 1990).

Conservation action to date

The red brocket deer is one of the focal species in a community-based wildlife management initiative in the Tamshiyacu-Tahuayo Community Reserve of the Peruvian Amazon.

Recommended conservation action

Initiate preliminary research to determine status of each subspecies. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.

Reporters: Richard Bodmer (Peru), Richard La Val (Costa Rica), Dan Brooks (Paraguay), J. Rudolf Dietrich (Venezuela).

Greater red brocket *Mazama bororo*

Southern Brazil

CITES: Not listed

1996 IUCN Red List Category:

LR(lc); DD (DSG recommended)

Distribution and status in the wild

This taxon has been proposed as a new species (Duarte and Giannoni 1996), but has not yet been formally described with vouchered material. The exact distribution of this species is not known with certainty, as it was only discovered in 1992 (Duarte and Giannoni 1996). A population is known to exist in an isolated patch of Atlantic rain forest near the city of Capao Bonito in the state of São Paulo. It is not known to exist in any protected areas. Duarte and Giannoni (1996) believe it “may be endangered because isolated patches of Atlantic forest are all that remain in the region.”

Past distribution and status

The extent of the former range of the species will never be known since most Atlantic rain forest, which presumably contained suitable habitat for this species, has been cut. A taxonomic revision of the all known specimens of *Mazama* from Brazil might uncover specimens of this species, which could help delineate the species' former range.

Status in captivity

None are known to exist in captivity.

Ecology and reproduction

No information available.

Uses

No information available.

Causes of decline and present threats

There are no statistics on the population status of the species, either before or at present, but destruction of habitat is the likely cause of its very restricted distribution.

Field studies

The only work underway at present is an investigation of the karyology and systematic relationships of this putative species to other *Mazama* taxa (Duarte and Giannoni, *ibid.*).

Conservation action to date

None.

Recommended conservation action

1. The biologists who have discovered the greater red brocket on the basis of its distinct karyology should publish a scientific description of the species to establish its biological reality.
2. Support a status survey of the species in all patches of Atlantic rain forest in São Paulo state (Brazilian conservation NGOs).

3. Establish protected area(s) to encompass remaining habitat in which the species occurs.
4. Initiate an ecological field study of the population(s) to determine habitat relations and to monitor that population.
5. Begin an educational campaign in the vicinity of the remaining habitat to enlist local support for the species' conservation.

Reporter: J. Mauricio Barbante Duarte.

Peruvian dwarf brocket *Mazama chunyi*

Bolivia, southern Peru

CITES: Not listed

1996 IUCN Red List Category: DD

Distribution and status in the wild

This species is known from a small number of specimens in museums, and very little is known about the extent of its geographical distribution or the status of its populations. In Bolivia, it has been reported from Cocapuno (Lareraja Province, Pelechuco, and Ulla Ulla [Franz Tamayo Province]), and Ríos Accromarca and Unduavi (South Yungas Province), all in Depto. La Paz (Jungius 1974; Jensen *et al.* 1994; T. Tarifa, pers. comm.).

Past distribution and status

Prior to 1959, when it was recognized as a distinct species, the Peruvian dwarf brocket was confused with the northern pudu (*Pudumephistophiles*). Hershkovitz (1982:59) reported that it "is common in the southern Peruvian departments of Cuzco, Puno, and Madre de Dios in habitats appropriate for the northern pudu. Information on the distribution of small deer in southern Peru is meager, and identifications often have been equivocal or based on hearsay."

Status in captivity

There are no known records of the species in captivity.

Ecology and reproduction

While it is likely that the Peruvian dwarf brocket is a browsing deer of the undergrowth, details of its ecology are unknown.

Uses

The species is probably a source of meat and hides.

Causes of decline and present threats

No published information is available on the species, but it is likely that it is killed by subsistence hunters.

Field studies

None known.

Conservation action to date

None known.

Recommended conservation action

1. Determine the distribution and status of the species within the range countries, and in particular within protected areas.
2. Initiate an ecological field study within a protected area, or an area where populations exist with minimal human impact.
3. Investigate the extent of subsistence hunting on the species within various parts of its range.

Reporters: J.F. Eisenberg (USA), Teresa Tarifa (Bolivia).

Brown brocket or grey brocket *Mazama gouazoubira*

M. g. argentina, *M. g. cita*, *M. g. mexicanae*, *M. g. murelia*, *M. g. nemorivaga*, *M. g. permira*, *M. g. sanctaemartae*, *M. g. tschudii*: Ecuador, Colombia, Venezuela, Trinidad, Guyana, Surinam, French Guiana, Brazil, Argentina, Uruguay, Peru, Bolivia

CITES: Not listed

1996 IUCN Red List Category:

LR(lc); DD (DSG recommended)

Distribution and status in the wild

Range extends from southern Central America down through northern South America, and reaches as far south as northern Argentina and Uruguay (Nowak and Paradiso 1983). Known distribution by country is:

Argentina: Reportedly occurs in Formosa Province; east of La Rioja, Chaco Province; Catamarca, northeast of San Luis; east of Tucumán, Salta Province; Jujuy Province; Santiago del Estero, north of Córdoba; Misiones Province; Corrientes; north of Entre Ríos (M. Merino, pers. comm. 1994).

- *Protected areas:* Pilcomayo National Park, Chaco National Park, Iguazú National Park, El Rey National Park, and Calilegua National Park.

Bolivia: Occurs in Departments Beni, Cochabamba, La Paz, Pando, Santa Cruz, and Tarija (Anderson 1993).

- *Protected areas:* Territorio Indígena Parque Nacional Isiboro-Sécure, Parque Nacional Amboró, Reserva de la Biósfera Estación Biológica Beni, Reserva Nacional Manuripi-Heath, and Parque Nacional Noel Kempff Mercado.

Brazil: Occurs in the Pantanal (L. Pinder, pers. comm. 1994).

Paraguay: Probably well distributed throughout the middle to upper Chaco region of Paraguay where total numbers have been estimated at 10,000. Densities are less in the developed central Chaco region where hunting is intensive (Brooks, undated).

- *Protected areas:* No information.

Panama: Insular population on Isla San José, off southern Panama (Nowak and Paradiso 1983).

- *Protected areas:* No information.

Peru: Occurs throughout the Amazonian region and is generally less common than *M. americana*.

- *Protected areas:* The protected areas that have populations of *M. americana* in the Peruvian Amazon include Manu National Park, Tambopata-Candamo Reserve Zone, and Tamshiyacu-Tahuayo Community Reserve.

Uruguay: Reportedly abundant in forested areas (I. Verdier, pers. comm.), which cover some 5% of the country.

- *Protected areas:* No information.

Venezuela: Up to 900m in northwestern Venezuela, in the states of Zulia, Falcon, and Lara. Occurs at low density (J.R. Dietrich, pers. comm.).

- *Protected areas:* Cerro Santa Ana Natural Monument.

Past distribution and status

No information.

Status in captivity

Table 3. Status of *Mazama gouazoubira* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
Venezuela	Gustavo Rivera Zoo	?	?	D. Brooks, pers. comm.
Uruguay	San Carlos Zoo	?	8	S. Gonzalez, pers. comm. 1994
	Piriapolis Zoo	1.4.0	5	S. Gonzalez, pers. comm. 1994

For internationally held stock see ISIS (1993). The species is undoubtedly maintained in a number of other zoos in South America.

Ecology and reproduction

Habitat and food preference: In Paraguay, utilizes a range of habitats including scrub and seasonally inundated marsh (D. Brooks, undated, pers. comm.). In rain forests, brown brockets are predominantly frugivores with fruit making up around 80% of their diet. Brown brockets prefer the drier habitats in the Amazon region and avoid the flooded areas.

Average group size and dispersion pattern: Generally solitary (D. Brooks, undated).

Movements: No information.

Reproduction: Single fawns may be dropped throughout the year, although a birth peak is reported during mid-winter (Stallings 1986; D. Brooks, undated). Gestation period is about eight months (Whitehead 1993) and there is evidence that post-partum conceptions allow two offspring to be born in a single year (Stallings, *ibid.*). In western Amazonia, the brown brocket appears to reproduce throughout the year (Bodmer, unpublished data).

Uses

Subsistence: In Paraguay, hunted for meat (Brooks, undated).

Commercial: In Paraguay, meat is widely sold in local markets of the central Chaco (D. Brooks, undated). In Amazonian cities, the meat of the brown brocket is sold in smaller quantities than the red brocket (*Mazama americana*). Hunters in the Peruvian Amazon receive

around US\$15 for the meat of one adult. Pelts of brown brockets are not traded in the Peruvian Amazon.

Causes of decline and present threats

In Paraguay, intensive hunting in the central Chaco has reportedly resulted in a local decline (D. Brooks, undated); in Venezuela, habitat destruction and illegal hunting may pose a threat, especially in the vicinity of settlements and roads (J.R. Dietrich, pers. comm.).

Field studies

Field survey in Paraguay by Brooks (D. Brooks, undated); Bodmer (ecological studies in Peru) (Bodmer 1988, 1989a, 1989b, 1990).

Conservation action to date

The brown brocket is one of the focal species in a community-based wildlife management initiative in the Tamshiyacu-Tahuayo Community Reserve of the Peruvian Amazon.

Recommended conservation action

Initiate preliminary research to determine status of each subspecies. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.

Reporters: Dan Brooks (Paraguay), J. Rudolf Dietrich (Venezuela).

Brazilian dwarf brocket *Mazama nana*

Argentina, Brazil, Paraguay

CITES: Not listed

1996 IUCN Red List Category:

LR(lc); DD (DSG recommended)

Distribution and status in the wild

Known from a small sample of specimens in museums, this species was formerly included within the little dwarf brocket, *Mazama rufina* (see Redford and Eisenberg 1992). The extent of its geographical distribution and the status of its populations remain to be learned.

Past distribution and status

According to Eisenberg (pers. comm.), the species is confined to moist forest areas of eastern Brazil, northeastern Argentina, and adjacent Paraguay.

Status in captivity

There are no known records of the species in captivity.

Ecology and reproduction

The Brazilian red brocket probably resembles the other dwarf brockets (*M. rufina* and *M. chunyi*) in many aspects of its ecology, and merits detailed study in the field. According to Crespo (cited in Eisenberg, in prep.), a single spotted fawn is born between September and February in northeastern Argentina. The habitat in eastern Paraguay is moist forest with an understory of bamboo thickets.

Uses

Unknown.

Brazilian dwarf brocket (*Mazama nana*).



R. Wirth

Causes of decline and present threats

Little information is available on the species, but it is likely that its populations are being fragmented by the decline of the moist lowland forests within its range.

Field studies

None known.

Conservation action to date

None known.

Recommended conservation action

1. Determine the distribution and status of the species within the range countries, and in particular within protected areas.
2. Initiate an ecological field study of the species within a protected area, or an area where populations exist with minimal human impact.

Reporter: J. F. Eisenberg.

Yucatan brown brocket *Mazama pandora*

Yucatan peninsula, Mexico

CITES: Not listed

1996 IUCN Red List Category:

LR(lc); DD (DSG recommended)

Distribution and status in the wild

The range of the species is not completely known, but includes most of the Yucatan peninsula, and possibly extends into northern Guatemala and Belize. It is known to occur in at least one protected area, the Calakmul Biosphere Reserve in the state of Campeche (Medellin *et al.*, in press). A subsistence hunting study identified this species as being hunted in an area adjacent to the Sian Ka'an Reserve, but due to taxonomic uncertainty, it was not distinguished from the red brocket deer, *Mazama americana* (Jorgenson 1993; R. Medellin, pers. comm.). The species seems to be fairly abundant locally, and in some parts of Yucatan it seems to be more common than the brown brocket.

Past distribution and status

No information available.

Status in captivity

At the time of writing, there are two captive Yucatan brown brockets in a private zoo near Mexico City (La Siberia, Texcoco, Mexico State).

Ecology and reproduction

Little is known about the ecology of this species. For many years it was considered to be a disjunct population of the brown brocket deer. The occurrence of a brown colored brocket, different from the red brocket, has been recognized for many years by the Mayan Indians, Club Safari International (A. Rivera, pers. comm.), Mexican hunters (J.M. Reyes, pers. comm.) and a few academicians (e.g. Merriam 1902; Leopold 1959). It is likely that subsistence hunting studies have lumped the Yucatan brown brocket and the red brocket for lack of clear diagnostic characters. Thus, Jorgenson (1993) assumed all brockets in his study area were red brockets.

Uses

Subsistence: The species is hunted throughout Yucatan for meat. Brockets (both *M. pandora* and *M. americana*) accounted for 4% of the total number of mammals (0–18% monthly range) and 10% of the fresh biomass hunted by Mayan Indians in central Quintana Roo (Jorgenson 1993).

Causes of decline and present threats

The species is currently a staple food of the Mayan people, but undoubtedly has also been hunted for many centuries. The effects of hunting on local populations, as well as the effects of deforestation should be examined. The Yucatan peninsula has two large Biosphere Reserves. The Yucatan brown brocket has been confirmed to exist in one of them (Calakmul Biosphere Reserve), and it likely occurs in Sian Ka'an Reserve as well. Confirmation and status surveys are needed. The species is also known to occur in an area of Yucatan that has been sustainably managed for timber production and other forest products for at least two decades.

Field studies

No available information.

Conservation action to date

None known.

Recommended conservation action

1. Initiate a survey to determine the abundance, habitats, threats and range of the species in Yucatan and adjacent areas.
2. Initiate an ecological field study of species in a protected area and in the managed forest mentioned above. In particular, research should attempt to understand the habitat relations, and interspecific relations with other species of *Mazama*.

Reporter: Rodrigo Medellín.

Pampas deer *Ozotoceros bezoarticus*

O. b. bezoarticus: Brazil, Uruguay, Paraguay

O. b. celer: Argentina

O. b. leucogaster: Brazil, Bolivia, Paraguay, Argentina

CITES: I

1996 IUCN Red List Category:

O. bezarticus – LR(nt)

O. b. bezoarticus – LR(nt)

O. b. celer – EN(B1+2cde, C2a)

O. b. leucogaster – LR(nt)

Distribution and status in the wild

The Pampas deer occurs in insular populations in western, northern, and central Argentina, eastern Bolivia, central and southern Brazil, Paraguay, and Uruguay (Nowak and Paradiso 1983; I. Verdier, pers. comm.). The Pampas deer was given the status of “Natural Monument” in the Buenos Aires Province of Argentina and in Uruguay. In both cases, the legislation was based on the Pan American Convention. This status affords the species special legal considerations in providing for its protection.

Argentina: *O. b. celer* occurs in the La Travesía zone, Central San Luis province, and in Buenos Aires province at Samborombón Bay. The San Luis population was estimated at 250–300 animals in 1980 (M. Gimenez-Dixon 1991), a decline from over 300 in 1963 (J. Jackson, pers. comm.). The Samborombón Bay population was about 300 animals in 1988 (M. Gimenez-Dixon, pers. comm. 1994). *O. b. leucogaster* occurs in the extreme north of Argentina in the Corrientes region (estimated 80 animals) (CBSG 1993).

- *Protected areas*: The Samborombón Bay area contains three reserves. Pampas deer are fully protected in a total of 4,000ha in Campos del Tuyú Wildlife Reserve, where there were c. 70 animals in the late 1980s (an increase from 14 in 1979) (Mariano Merino, pers. comm. 1994). In the two provincial reserves (Bahío de Samborombón and Rincón de Ajó), which combined total 11,600ha, protection is considered inadequate since there is no personnel or infrastructure (Mariano Merino, pers. comm. 1994). The entire coastal region is officially closed to hunting and has been proposed as a protected area (M. Gimenez-Dixon, pers. comm. 1994).

Bolivia: *O. b. leucogaster* occurs in two confirmed locations: Pampa Aguada in the southwestern section of the Noel Kempff Mercado National Park and at Santa Cruz (Cerranías de Concepción), de la Sierra Department (M. Merino, pers. comm. 1994). There are no data regarding the size of the populations (CBSG 1993). Status in the remainder of the country is unknown.

- *Protected areas*: Isiboro Sécore National Park (WCMC 1992) and possibly Noel Kempff Mercado and El Beni National Parks (Tarifa, pers. comm.).

Brazil: *O. b. bezoarticus* occurs in central and southwestern Brazil and *O. b. leucogaster* in central and southern Brazil. Populations are present in Mato Grosso, Goiás, Mato Grosso do Sul, Minas Gerais, São Paulo, and Rio Grande do Sul States. Both subspecies were considered to be restricted in distribution and at low densities (L. Pinder pers. comm.), but total numbers have been recently estimated by aerial and terrestrial census at 42,000 animals (CBSG 1993).

- *Protected areas*: Emus National Park population estimated at 270 animals (management plan exists but does not provide specifically for the management of *O. bezoarticus* and protection is inadequate); Charade dos Veadeiros National Park; Brasília National Park (no management plan, population thought to be decreasing); Serra da Canastra National Park (protection adequate, no management plan); and Araguaia and Tocantins National Parks. (WCMC 1992; L. Pinder, pers. comm.). Possibly also occurs in Aparados da Serra, Chapada dos Guimaraes, and Grande Sertao Veredas National Park (fewer than 50 animals) (L. Pinder and I. Verdier, pers. comm.).

Paraguay: *O. b. leucogaster* reported from northeast Paraguay, to the north of Concepción, during the 1970s, and in the Chacoan Pampas during the late 1980s (D. Brooks, pers. comm.). There are no data regarding the size of the populations (CBSG 1993).

- *Protected areas*: Possibly Teniente Enciso (D. Brooks, pers. comm.).

Uruguay: *O. b. bezoarticus* restricted to insular populations

of variable size. Total numbers estimated between 800–1,000. Largest population in Salto State where c. 700 animals are present and probably increasing (S. González, pers. comm. 1994). Los Ajos (Rocha state) has a population of about 100 deer, a decline from an estimated 300 animals in 1963 (S. González, pers. comm. 1994). Small populations are present in Artigas, Rio Negro, and other departments. These may be close to extinction. (D. Muller-Schwarze and D. Moore, pers. comm.).

- *Protected areas*: Only occurs on private land (S. González, pers. comm. 1994).

Past distribution and status

Prior to early 1800s, the Pampas deer was abundant throughout the grasslands of eastern South America; the northern subspecies *O. b. bezoarticus* extended across much of central and southern Brazil as far as northern Uruguay; the central subspecies *O. b. leucogaster* throughout southwestern Brazil, southeast and eastern Bolivia, Paraguay, and the extreme north of Argentina; and the southern subspecies *O. b. celer* throughout the Argentinean Pampas (Jackson 1978b).

Status in captivity

Table 4. Status of *Ozotoceros bezoarticus* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
Uruguay	Piriapolis Zoo	11.16.0	27	S. González, pers. comm. 1994
	Sierra Durazno	?	14	S. González, pers. comm. 1994
	San Carlos Zoo	1.2.0	3	S. González, pers. comm. 1994
	Salto	?	7	S. González, pers. comm. 1994
Argentina	Estancia	4.8.0	~14	Merino 1993a
	La Corona	7.2.0	9	Merino, pers. comm.
	Santa Fe Zoo	?	14	S. González, pers. comm. 1994
	Estacion Zoo	1.1.0	2	DSG 1988

An additional 23 animals were held in captivity outside the range countries in 1992 (CBSG 1993). International studbook keeper is Dr Hans Frädriich, Zoologischer Garten Berlin, Hardenbergplatz 8, D-1000 Berlin 30, Germany.



Susana González

Pampas deer (*Ozotoceros bezoarticus*), Uruguay.

Ecology and reproduction

Habitat and food preference: Occupies a range of open habitats, in particular grassland. In Argentina, the species utilizes a range of habitats including coastal salt marsh. In Uruguay and central Brazil, it is found in dry temperate grasslands in hilly areas (IUCN 1976; Jackson and Langguth 1987). The Pampas deer is a highly selective feeder, utilizing grasses, forbs, and browse (J. Jackson, pers. comm. 1994).

Average group size and dispersion pattern: In Emus National Park, Brazil; usually solitary, but aggregations of up to 50 animals have been recorded during the wet season (Redford 1987). There are no strong seasonal trends in Uruguay or Argentina; the species aggregates in small groups of up to six animals throughout the year (Jackson and Langguth 1987).

Movements: No information.

Reproduction: Single fawn born August–April (Jackson and Langguth 1987) following gestation of about seven months (Frädrieh 1981).

Uses

Subsistence: Originally hunted by indigenous people for meat, hides, and other products (medicine; reputed to have “bezoar stones” of supposed medicinal value against snake venom) (Jackson and Langguth 1987).

Commercial: Hides were exported on a very large scale during the 19th century, with over two million traded between 1860–70 (Jackson and Langguth 1987). In Bahia,

Brazil, meat is sold on local markets. A trophy head from Uruguay may bring US\$2,000 in Argentina (D. Moore, pers. comm.).

Causes of decline and present threats

Argentina: Over-exploitation for food, hides, and sport, habitat conversion for agriculture, competition with domestic livestock, and possibly introduced bovine disease (Jackson and Langguth 1987). In the Samborombón Bay area, feral pigs are also a concern.

Brazil: Hunting, habitat conversion for agriculture, and possibly bovine disease (Redford 1987; L. Pinder, pers. comm.). Predation by feral dogs is a problem within some protected areas (L. Pinder, pers. comm. 1994).

Paraguay: Principally hunting (D. Brooks, pers. comm.).

Uruguay: Habitat conversion for cattle grazing, rice agriculture, competition with livestock, hunting, predation by domestic dogs, and possibly bovine disease (D. Muller-Schwarze and D. Moore, pers. comm.; I. Verdier, pers. comm.).

Field studies

Argentina: Jackson and Langguth (1987); J.J. Bianchini and J.C. Luna Perez; M. Gimenez-Dixon (Samborombón Bay population); M. Merino (Samborombón Bay population: diet); Javier Beltrán (Campos del Tuyú population).

Bolivia: Teresa Tarifa.

Brazil: F. Leeuwenberg; L. Pinder (behavior, ecology and diet); Redford (1987); M. Barbanti Duarte (reproduction and genetic studies).

Uruguay: D. Moore and D. Müller-Schwarze (behavioral ecology in Salto State); I. Verdier (past studies carried out in Los Ajos and Rocha); S. González (demographic and genetic studies); R. Lombardi (Los Ajos population, Jackson and Langguth 1987).

Paraguay: W. Sosa Yubero.

Conservation action to date

Argentina: Captive breeding program established in 1968/69 using founders from Samborombón. The population is reportedly declining and no reintroductions have been made (Jackson and Langguth 1987). Upon termination of

IUCN/WWF Project 1303 in 1979, activities were continued by the government of the province of Buenos Aires. These activities included the creation of the two provincial reserves mentioned for Samborombón Bay, field studies and aerial surveys, anti-poaching activities, and affording the species greater legal protection. Anti-poaching measures and aerial counts have been carried out since 1975 (Jackson and Langguth 1987; Gimenez-Dixon 1991).

Brazil: Tax exemptions are being considered by the government in order to stimulate private activity toward conservation of the species (González 1993).

Uruguay: Population increases in Salto State have resulted from protection by a local estate owner (D. Müller-Schwarze and D. Moore, pers. comm.). In 1986, a small group of captive-bred deer were successfully reintroduced to a protected area in El Potrerillo (S. González, pers. comm. 1996).

A Population and Habitat Viability Assessment (PHVA) for the species took place on 25–30 October 1993, and recommended several initiatives for improving captive population management, and actions for local governments, organizations, and landowners (S. González *et al.* 1993).

Recommended conservation action

1. Survey those localities in which Pampas deer presence is confirmed but status is unknown, as well as those areas where presence is suspected (CBSG 1993). Activities should include field reconnaissance, population censuses, demographic surveys, and investigations into human use of the animals.
2. Support continued ecological research; focus principally on competition with livestock, and feeding biology and nutritional needs of populations in natural climax grassland. Initiate standardized and repeated population censuses to determine population trends. Evaluate taxonomic status of the Uruguayan race of *O. bezoarticus*. Carry out the following studies of the Samborombón coastal area: carrying capacity; interaction with wild boar and livestock; human use of the unprotected part of the coast (M. Gimenez-Dixon, pers. comm. 1994).
3. Strengthen existing protected areas management; many are without management plans and where these exist they do not usually focus on Pampas deer management. Many protected areas are poorly resourced and suffer poaching and agricultural encroachment. Develop community based initiatives to minimize livestock encroachment and habitat conversion.
4. Create new protected areas, where possible, for threatened populations outside existing network. In

Argentina, establish reserves to protect the Corrientes and San Luis populations.

5. Establish collaborative captive breeding programs with initial focus on critical Argentine population. Capture and breeding should be carried out by trained personnel only, and consideration should be given to establishing international training programs, using CBSG expertise.
6. Enlist cooperation of local landowners in maintaining the species, possibly in conjunction with ecotourism programs.

Reporters: Manuel de Anchorena (Argentina), John Jackson (UK); Laurenz Pinder (Brazil); Dan Brooks (Paraguay); Don Moore and Ignacio Verdier (Uruguay); Dietland Muller-Schwarze (USA); Mariano Gimenez-Dixon (Argentina); Marcello D. Beccaceci (Argentina); Mariano Merino (Argentina); Susana González (Uruguay).

Northern pudu *Pudu mephistophiles*

Colombia, Ecuador, Peru

CITES: II

1996 IUCN Red List Category: LR(nt)

Distribution and status in the wild

Occupies a discontinuous and probably fragmented range through the montane forests and grasslands of the Andes in Colombia, Ecuador, and Peru. Exact range is unknown and distributional gaps between records are unresolved. Occurs between 3,000–4,000m (Hershkovitz 1982; Cabrera 1961) at low density).

Colombia: Central Cordillera of southern Colombia; northeast of the Valle de las Papas; northward through the Paramos of Sotara, Purace, Las Delicias, Guanacas, and Moras (Cauca administrative Department), to the Paramo of Las Hermosas (Valle Department). Possibly occurs in the region of Paramos de Barragán to the east of Tulua (Hershkovitz 1982; Albuja 1991).

• *Protected areas:* Los Katios and Purace National Parks and probably Los Nevados, Las Hermosas, Nevado del Huila, Munchique, and Cueva de los Guácharos National Parks (Hershkovitz 1982).

Ecuador: Occurs in the Oriental Cordillera, and may still be present south of the Rio Pastaza in the Paramos of Huancabamba, on the border with Peru. Possibly also present in northern Ecuador (Albuja *et al.* 1980; Albuja 1991; Hershkovitz 1982).

- *Protected areas:* Bangay and Podocarpus National Parks (WCMC 1992); also Bosque Protector El Angel, Reserva Cayambe Coca, and Reserva Antisana.

Peru: Northern and central Peru, where populations are apparently isolated from those in Ecuador (Hershkovitz 1982; Albuja 1991).

- *Protected areas:* Rio Abiseo National Park (C. Ascorra, pers. comm. 1994).

Past distribution and status

Probably more widely distributed throughout the region in the past (Hershkovitz 1982).

Status in captivity

None in 1982 (Hershkovitz 1982).

Ecology and reproduction

Habitat and food preference: Temperate dry zone forests and fringing Paramo grassland above the tree line (Hershkovitz 1982). Chaparros altoandinos at about 4,000m elevation.

Average group size and dispersion pattern: Probably solitary (Hershkovitz 1982).

Movements: No information, but seasonal altitudinal migrations are possible.

Reproduction: Possibly two breeding seasons with fawning in March–April and October–November. Gestation period is approximately 6–7 months (Whitehead 1993).

Uses

Subsistence: Hunted by local people for meat and hides (Hershkovitz 1982).

Commercial: No known commercial uses.

Causes of decline and present threats

Intensively exploited by local people during at least the last 35 years. Predation by domestic dogs and habitat conversion probably pose serious additional threats (Hershkovitz 1982).

Field studies

No information.

Conservation action to date

None.

Recommended conservation action

1. Little is known of the species status or ecology. Undertake comprehensive status surveys and develop research program to determine ecology, habitat requirements, population biology, and extent of threats.
2. Strengthen existing protected areas management where necessary. Some protected areas are without management plans and many receive insufficient resources to enable adequate protection.
3. In areas where subsistence hunting proves to be a serious threat, seek alternative subsistence schemes or more sustainable harvesting methods. Develop conservation education programs and increase law enforcement if necessary.

Reporters: D. Müller-Schwarze (USA); Luis Albuja (Ecuador).

Southern pudu *Pudu puda*

Chile, Argentina

CITES: I

1996 IUCN Red List Category: VU(A1c,d,e)

Distribution and status in the wild

Occurs at low density in lowland and hill forests, between sea level and 1700m (Miller *et al.* 1973), in southern Chile and some adjacent areas of southwestern Argentina. Total population is thought to be less than 10,000 animals. (E. Ramilo, pers. comm.; Hershkovitz 1982; MacNamara and Eldridge 1987).

Argentina: Range extends from southwest Neuquén Province, southward along the foothills of the Andes, into southwest Santa Cruz Province (Hershkovitz 1982).

- *Protected areas:* Occurs in Los Alerces, Anexo Puelo, Lago Puelo, and Los Arayanes National Parks (Hershkovitz 1982; WCMC 1992), and possibly also in Lanín National Park. Reportedly introduced to Nahuel

Huapi National Park (Victoria Island) following almost complete extirpation (E. Ramilo, pers. comm.).

Chile: Range extends southward from Maule Province as far as the Strait of Magellan (Hershkovitz 1982). J. Jimenez (pers. comm.) doubts the species was verified as occurring in Magallanesian Southern Chile.

- *Protected areas:* Occurs in Conguillo, Los Paraguma, Nahwelbuta National Parks (WCMC 1992), and Vicente Perez Rosales National Park, where it was reportedly abundant during the early 1980s (Hershkovitz 1982). Also occurs in Laguna San Rafael, Puyehue, and Pirihueico National Parks, where its status is unknown (Hershkovitz 1982). Reportedly present in a number of smaller protected areas (E. Ramilo, pers. comm.; J. Jimenez, pers. comm.), and is relatively abundant on Chiloe Island, and on the mainland in Luanquehue Province in both pristine and secondary forest.

Past distribution and status

Range has probably diminished considerably and fragmented in recent decades (Eldridge *et al.* 1987).

Status in captivity

Country/State	Institution	Population structure		Year Ref.
		Total		
Chile	Universidad de Concepcion	?	50	1989
Chile, Osorno	Private collection of A. Neumann	?	?	J. Jimenez 1995

(Source: E. Reyes Toledo, pers. comm. 1990).

Southern pudu (*Pudu puda*).



Zoological Society of San Diego

For internationally held stock see ISIS (1997). An international studbook is maintained by U. Schürer and Gea Olbricht (Wuppertal Zoo, Wuppertal, Germany).

Ecology and reproduction

Habitat and food preference: The southern pudu inhabits dense temperate forest where it browses mainly foliage and shoots (Miller *et al.* 1973; Hershkovitz 1982). It is also common in disturbed forests, as long as it is not harassed by people and especially dogs. It feeds on new leaves and shoots of native trees, avellanas fruit (*Gevuina avellana*), many forb species, and especially the flowers of a few abundant exotics (J. Jimenez, pers. comm. 1996).

Average group size and dispersion pattern: Solitary, except during the rut, and in spring when young accompany mothers (Hershkovitz 1982).

Movements: Hershkovitz (1982) reported there are no seasonal movements, but data are lacking.

Reproduction: Single fawn born during November and December following a gestation period of around seven months. Age at first reproduction may be as early as six months (Hershkovitz 1982).

Uses

Subsistence: Hunted for food and skins (E. Reyes Toledo, pers. comm.), and heavily poached for the captive animal trade (J. Jimenez, pers. comm.).

Commercial: Fetches a high price in the illegal zoo trade (DSG 1991).

Causes of decline and present threats

The species is thought to have undergone rapid decline in recent years as a result of poaching and illegal collecting for zoos and private collections (DSG 1991). Habitat conversion, predation by domestic dogs, and competition with exotic deer and domestic livestock are serious associated threats (Eldridge *et al.* 1987).

Field studies

Eldridge *et al.* (1987) (activity patterns and habitat utilization).

Conservation action to date

Argentina: Captive breeding program in Parque Nacional Nahuel Huapi.

Chile: A captive breeding program is currently underway (Concepcion University, Chile) and there are plans to reintroduce animals into three national parks (E. Reyes Toledo, pers. comm.).

Recommended conservation action

1. Initiate coordinated research to examine habitat requirements, food habits, and behavioral ecology. Determine impact of poaching and undertake status

surveys to establish extent of habitat decline and forest fragmentation. Use information to identify priority areas for southern pudu conservation and develop coordinated program to manage species throughout range.

2. Strengthen existing protected areas management. Many national parks and protected areas are without management plans and receive insufficient resources to enable effective protection.
3. Continue captive breeding program; reinforce captive stock with introductions of wild-caught animals; genetically manage the international captive population to reduce inbreeding; and conduct research on reproduction, nutrition, and behavior.

Reporters: Eugenia Reyes Toledo and Matilde Valverde Hott (Chile), Jaime E. Jimenez (Chile).

Europe, Middle East and Africa

Algeria, Corsica, England, Israel, Jordan, Lebanon, Morocco, Norway, Sardinia, Sierra Leone to Uganda, Tunisia, Wales

Synopsis

During the past century, cervid populations throughout much of Europe have undergone substantial change. In western Europe, native species such as red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), moose (*Alces alces*), and reindeer (*Rangifer tarandus*), experienced dramatic increases in numbers and have expanded their ranges as plantation forestry has increased and hunting has declined. The roe deer (*C. capreolus*) has been particularly successful in utilizing lowland woodlands and agricultural habitat, and is today expanding throughout much of its range. It has recolonized areas from which it became extinct in recent historical times (e.g. Norway, and England and Wales). The red deer too has expanded its range considerably throughout most of western Europe, particularly in the Alps and in parts of Scandinavia. Since the post-war period, both moose and reindeer have expanded their ranges and increased in numbers throughout much of Scandinavia. Declines in western Europe have been few with only one subspecies of red deer (*C. e. corsicanus*) considered Endangered (see page 56). In North Africa, two subspecies are of conservation concern. Algeria and Tunisia are the last refuges for *C. e. barbarus* (Lower Risk, near threatened; see page 56), which has recovered dramatically from a few hundred animals in the early 1970s to reach approximately 4,000 by the 1980s.

The situation is far from clear in Central and Eastern Europe. In Central Europe, for example, the roe deer has been extremely successful, expanding its range and numbers by utilizing open agricultural fields. There is a paucity of information on the deer fauna in the former USSR, although several threatened species are reported. These species occur in the southern mountains along the borders of China and Afghanistan, and include three subspecies of musk deer (*Moschus moschiferus moschiferus*, *M. m. parvipes*, and *M. m. sachalinensis*) (all Vulnerable) and the Bukhara deer (*C. e. bactrianus*) (Vulnerable).

The status of the water chevrotain (*Hyemoschus aquaticus*) is not well known on a national basis across its extensive range. There is some evidence that it is declining in specific areas, but first-hand information is scarce. Surveys should be undertaken in protected areas in each range country to determine presence and abundance, as well as threats. The most urgent short term challenges in the region are to implement initiatives to conserve the

Corsican red deer (*C. e. corsicanus*) in Corsica and Sardinia (see page 56). Status surveys and an evaluation of present threats for the taxa are prerequisites for implementing management, and these should receive priority support. Cooperation and consultation with relevant agencies in states of the former USSR should be investigated. The long-term outlook is to initiate conservation programs in the central and eastern European region.

African chevrotain or water chevrotain *Hyemoschus aquaticus*

From Sierra Leone to Uganda

CITES: – III (Ghana)

1996 IUCN Red List Category:

LR(nt); DD (DSG recommended)

Distribution and status in the wild

Occurs in the lowland forest zone, from Sierra Leone to western Uganda, where it is probably declining (Nowak and Paradiso 1983). Population density in Gabon has been recorded at 7.7–28 animals per km² (Dubost 1978). It is still reported to be commonly seen by local people in Gabon (G. Schwede, pers. comm. 1994).

Past distribution and status

No information.

Status in captivity

No information.

Ecology and reproduction

Habitat and food preference: Lowland evergreen forest usually within 250m of fresh water. Diet consists primarily of fallen fruit (Dubost 1978).

Average group size and dispersion pattern: Groups consist of an adult female and young. Males are solitary. There is no evidence of territoriality (Dubost 1978).

Movements: Females are sedentary following establishment of home range. Male movements are unknown (Dubost 1978).

Reproduction: A single fawn is born annually, following a gestation period of six to nine months. Sexual maturity is reached between 9–26 months, whereupon the young disperse (Dubost 1978). See Barrette (1987) for a review of Tragulid ecology and reproduction.

Uses

Subsistence: In Gabon, intensively hunted by local people for food (Dubost 1978).

Commercial: No information.

Causes of decline and present threats

Probably hunting (Nowak and Paradiso 1978).

Field studies

G. Dubost in Gabon (Dubost 1978).

Conservation action to date

None.

Recommended conservation action

Determine current status in the wild throughout the species' range. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the species.

Asia

Afghanistan, Bhutan, Cambodia, China, India, Indonesia, Iran, Iraq, Japan, Korea, Laos, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand, former USSR, Vietnam

Synopsis

The depletion of deer populations is occurring at an increasingly rapid pace throughout at least 18 countries in the Asian region. Human population growth, habitat conversion for industry and agriculture, and increasingly, intensive exploitation, have already pushed one species, Schomburgk's deer, to extinction, and a number of species and subspecies to the brink. Threatened taxa occur in 19 countries; ranging from Afghanistan and China in the west; to Mongolia in the north and India in the south; and eastward to Indochina and the Philippines in peninsular and insular Asia.

China, the center of deer evolution and dispersal in Asia, holds the largest number (16) of deer species and by far the largest numbers of threatened taxa. Of these, two species and two subspecies are Critically Endangered, two species and two subspecies Endangered, and two subspecies Vulnerable. The endemic Thorold's deer (*Cervus albirostris*) (Vulnerable) is now restricted to fragmented populations on the southeastern Tibetan Plateau, where it has declined primarily as a result of competition with domestic livestock and hunting. The Sika deer (*C. nippon*) has been intensively hunted for several hundred years in China for use in traditional medicine and four subspecies are now threatened. Of these, two (*C. n. sichuanicus* and *C. n. kopschi*) are Endangered, and two (*C. n. grassianus* and *C. n. mandarinus*) are Critically Endangered and probably on the brink of extinction. Although five taxa are designated as Lower Risk, the status of 13 subspecies is unknown (Data Deficient). This lack of data suggests the compelling need for surveys. Conservation efforts have generally focused on a protected areas network, but unfortunately some reserves are in need of management support and few have been established with cervid conservation in mind. Deer farming has been undertaken on a large scale in China and its impact on hunting, disease transmission, and hybridization should be investigated.

In southern Asia, India supports a number of threatened species and subspecies including both upland and lowland taxa. Of the lowland forms, the brow-antlered deer (*C. eldi eldi*) is Critically Endangered, with a single remaining population of between 100 and 150 in Keibul Lamjao National Park, Manipur. The species has declined due to agricultural reclamation of its unique wetland habitat,

and an integrated conservation strategy and management plan that meets the needs of local people is urgently required. The precarious nature of this subspecies highlights the need for a cooperative international captive breeding program with protocol for exchange and management of genetic stock. Of the upland forms, India supports ever-declining populations of musk deer (*Moschus chrysogaster* and *M. fuscus*), designated Lower Risk, near threatened, as well as an Endangered subspecies of red deer (*C. elaphus hanglu*).

Further east, Myanmar holds some seven threatened taxa (seven species, at least four subspecies) including thamin (*C. eldi thamin*) (Lower Risk, near threatened), which is no longer widespread and abundant in the central dry zone and should continue to be a primary focus for conservation action. The cervid fauna in insular and southeast Asia has been critically depleted in recent years, and many populations are close to extinction or under great threat. Several species or subspecies of Critically Endangered status persist in the region. Vietnam supports a very small population of sika (*C. nippon pseudaxis*) which is Critically Endangered and thought to be close to extinction in the wild. This has been the subject of an international captive breeding program since 1991, and there are plans to carry out reintroductions. The Indonesian island of Bawean is home to the Endangered Bawean deer (*Axis kuhli*), the cervid with the most restricted range in the world. It successfully recovered following an intensive study and management program, but requires continued monitoring. The Endangered *C. alfredi* is the focus of the "Philippine Spotted Deer Conservation Program", and a well-coordinated sister effort on the Endangered Calamian deer, *Axis calamianensis* has made encouraging progress.

In the wild, Persian fallow deer *Dama dama mesopotamica* (Endangered) have been reduced to two small insular populations. Of the 250 remaining Persian fallow deer, most are either in captivity or have been introduced.

The critical status of the Persian fallow deer in Iran highlights the need for in-country staff training in protected areas management together with support for the present captive breeding and reintroduction program.

Knowledge concerning the status of the Asian mouse deer (Tragulidae) is far from satisfactory, and merits a thorough investigation. No doubt many populations in

protected areas are secure, but a large number of insular populations have been unvisited since they were originally described nearly a hundred years ago. These subspecies populations are hereby classified Data Deficient and their taxonomic status should be investigated using modern molecular methods. The Balabac mouse deer (*Tragulus napu nigricans*) (Data Deficient), represents the only taxon for which information was received.

Given the extent of the threats and the number of threatened taxa in the region, the application of a coordinated conservation program for deer in Asia is long overdue. A large number of taxa are designated as Data Deficient, especially in Laos, Cambodia, and Myanmar, but also in several other countries. Concerted efforts are required to establish the status of these populations on a national basis. For species of better known status, priority should be given to those whose habitat is under greatest pressure, in particular lowland wetlands. Conservation aims will have to be achieved through cooperation with a range of national and international institutions, including development and land use planning agencies. More specific programs must focus on strengthening protected areas management (including provision of in-country training) and cooperative ex-situ activities following the model of the Philippine deer programs.

Eurasian moose or elk *Alces alces cameloides*

China, Eastern Mongolia

CITES: Not listed

1996 IUCN Red List Category: LR(nt)

Distribution and status in the wild

China: Occurs at low density in the mountains of northeastern China where populations are estimated at 10,000 (Hulung Beir Region); 3,660 (Da Xinganling Region); 2,740 (Xiao Xinganling Mountains); and 1,550 (Altai Mountains) (Ma Yiqing, pers. comm. 1990).

- *Protected areas:* Hanma and Huzhing Nature Reserves (protection is inadequate and there are no management plans) (Ma Yiqing, pers. comm. 1990).

Mongolia: No information.

Past distribution and status

Originally ranged over a much larger area of northwestern China, including the upper Shuifen River basin (Ma Yiqing, pers. comm.).

Status in captivity

Table 6. Status of *Alces alces cameloides* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
China	Harbin Zoo	1.2.0	3	1990*
	Beijing Zoo	2.1.0	3	1990
	Qiqihar Zoo	2.1.0	3	1990
	Shaen Yang	1.1.0	2	1990
	Bridge Park	1.1.0	2	1990
* (Ma Yiqing, pers. comm. 1990)				

Ecology and reproduction

Habitat and food preference: Taiga forests; browses on leaves, bark, and shoots, and grazes on aquatic plants and herbs (Ma Yiqing, pers. comm.).

Average group size and dispersion pattern: In winter, forms small family groups of 4–8 animals (Ma Yiqing, pers. comm.).

Movements: Migratory (Ma Yiqing, pers. comm.).

Reproduction: Calves during May and June (Ma Yiqing, pers. comm.) following a gestation of 240 days (Sheng and Ohtaishi 1993). Twins are relatively common and triplets occasional (Whitehead 1993).

Uses

Subsistence: Hunted by local people for meat, skin, and tendons. Hunting has declined since the 1950s (Ma Yiqing, pers. comm.).

Commercial: Tendons and other parts are used in traditional Chinese medicine and fetch a high price in local markets (Ma Yiqing, pers. comm.).

Causes of decline and present threats

Over-exploitation and habitat loss (Ma Yiqing, pers. comm.).

Field studies

Ma Yiquing (status); Yu Xiaochen (food habits); Xu Xueliang (Historical distribution); and Piao Renzhu (ecology and behavior in captive and wild populations).

Conservation action to date

Listed in second category of Chinese protected animals; protected areas established.

Recommended conservation action

1. Establish current status throughout range and determine trends. Evaluate levels of hunting and habitat loss.
2. Undertake ecological research to determine management requirements.
3. Strengthen existing protected areas management. Both reserves suffer from poaching and lack management plans and infrastructure. Establish management authorities for both reserves and develop and implement management plans.
4. Create new protected areas, where possible, for threatened populations outside existing network.

Reporter: Prof. Ma Yiqing.

Calamian deer *Axis calamianensis*

Philippines – Calamian Islands

CITES: Not listed

1996 IUCN Red List Category: EN(B1+3d)

Distribution and status in the wild

Philippines: Occurs only on the Calamian Islands, north of Palawan. Presently survives at low density on the larger islands of Busuanga Island (N and NE sectors) and Culion Island. There is also a population on Calauit Island, where 30 were introduced in 1977 to supplement a small relict population. Calauit currently holds the largest population, estimated in April 1994 to have increased to $1,123 \pm 236$ (Orig and Rosell 1994). A more recent estimate (Oliver 1996) places the population at about 550 animals. Small numbers of deer have been released on other islets in the group since 1988, but the status of these new colonies is unknown (Oliver 1993).

• *Protected areas:* While relatively large parts of Busuanga and Culion Islands are still undeveloped and sparsely inhabited, there are no proper reserves on either. Calauit Island Game Preserve and Wildlife Sanctuary (37.4km²) was established by President Marcos in 1976 to protect a collection of free-ranging African ungulates. Protection is inadequate and there are no management plans (Oliver 1993). Several hundred local people were

evicted at that time, but many of these have since returned to settle illegally (Oliver and Villamor 1993).

Past distribution and status

Originally known to exist only on three islands of the Calamian group – Busuanga, Culion, and Calauit. Presumably more widespread on smaller islands of the Calamian group in the past, but not known on Palawan or elsewhere in the region (DSG 1991; Oliver and Villamor 1993).

Status in captivity

Table 7. Status of *Axis calamianensis* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
USA	San Diego Zoo	7.8 (5)	20	1997

The Ecosystems Research and Development Bureau (ERDB) of the Busuanga Breeding and Experimental Station held three females in 1994. These animals were the remnants of an unsuccessful “backyard stock farming” project (Oliver and Villamor 1993; Oliver 1992, and unpublished data). See ISIS for internationally held stocks.

Calamian deer (*Axis calamianensis*), Philippines.



WWF/A. Petretti

Ecology and reproduction

Habitat and food preference: Frequents second growth scrub, woodland, and grasslands (W. Oliver, pers. comm. 1994).

Average group size and dispersion pattern: Up to 27 individuals, but usually 7–14 (much smaller groups reported in heavily hunted areas) (W. Oliver, pers. comm. 1994).

Movements: None reported.

Reproduction: Throughout the year.

Uses

Subsistence: Intensively hunted for food by local people; hides sometimes used for drumskins and antlers for decoration (W. Oliver, pers. comm. 1994).

Commercial: Venison is occasionally sold locally (W. Oliver, pers. comm. 1994).

Causes of decline and present threats

Hunting was particularly severe during the mid-1970s (Grimwood 1976) but has declined in recent years. The primary threat to the Calauit sanctuary is the “Back to Calauit Movement.” In 1986, 51 out of the 256 families evicted from the island ten years earlier re-settled on the island. By 1992, the settlers numbered nearly 500 individuals (Oliver 1993; pers. comm.).

On Calauit, African ungulate populations are increasing but probably not competing with Calamian deer. A presidential proclamation that precluded removal or control of exotic species, and the movement or management of Calamian deer on Calauit Island was recently amended, thereby enabling better future control of the exotic ungulate populations.

Field studies

An inter- and intra-population study of genetic variation is planned by Dr Karen Rose (Large Animal Research Group, Cambridge). Pauline Orig plans to conduct an ecological and behavioral study and is seeking a university affiliation.

Conservation action to date

According to Oliver (1993), the primary actions to date have included the reduction of the human population on Calauit Island, apparently a temporary measure, and the

development of the sanctuary. The Calamian Deer Conservation Program, launched in 1993 as a collaboration between the Philippine Department of Environment and Natural Resources (DENR) and the Zoological Society of San Diego, has instituted several initiatives. These initiatives include status surveys, research and management recommendations, and conservation education (Oliver 1996).

Recommended conservation action

1. Monitor current status on the three islands and determine trends. Evaluate levels of hunting and habitat loss.
2. Strengthen existing protected areas management; both reserves lack management plans, adequate infrastructure, and suffer from poaching. Establish management authorities for both areas and develop and implement management plans.
3. Incorporate buffer zones in the Calauit Game Preserve, enforce strict protection of the core area, and provide alternative settlement sites to those illegally living on the island.
4. Establish protected areas on Culion and Busuanga, based on habitat and deer status surveys.
5. Undertake behavioral and ecological research of Calauit deer to determine management requirements. Conduct more detailed studies in selected areas.
6. Initiate a conservation education program using Calamian deer as a flagship species to promote a wide variety of related conservation activities.

Reporter: William L.R. Oliver.

Bawean deer or Kuhl's deer *Axis kuhli*

Indonesia – Bawean Island

CITES: Not listed

1996 IUCN Red List Category: EN(D1)

Distribution and status in the wild

Endemic to Bawean Island (200km²), Java, where it is most abundant in the hilly central region. The population was estimated to total around 300 animals in 1980 and thought to be increasing (Blouch 1980).

Past distribution and status

Probably confined to Bawean Island since the Pleistocene. Reportedly plentiful during the 19th century. Increased in

numbers up to the 1950s following forest protection, and probably declined during the 1960s and early 1970s (WWF 1979).

- *Protected areas:* Bawean Island Nature Reserve.

Status in captivity

Country/State	Institution	Population structure		Year Ref.
		Total		
Java	Surabaya Zoo	?	~100	1991
Singapore	Singapore Zoo	?	30–40	1982

* The Surabaya population has been periodically reinforced using wild caught animals (Blouch and Sumaryoto 1987).

For internationally held stocks see ISIS (1993).

Ecology and reproduction

Habitat and food preference: Utilizes mainly secondary forest, but recently burned grassy openings are used during the dry season. Diet comprised of forbs, grasses, browse, and occasionally agricultural crops (Blouch and Sumaryoto 1987).

Average group size and dispersion pattern: Usually solitary (WWF 1979).

Movements: Not migratory, but tends to utilize uplands during the rainy season and lower areas in the dry season due to water availability (WWF 1979).

Reproduction: Single fawn between February and June on Bawean and year round in captivity (WWF 1979). Gestation period is seven months (Blouch and Sumaryoto 1987).

Bawean deer or Kuhl's deer (*Axis kuhli*).



C. Wemmer

Uses

Subsistence: Hunted for meat by local people until 1977 (Blouch and Sumaryoto 1987).

Commercial: None.

Causes of decline and present threats

Subject to uncontrolled hunting, probably since human settlement took place some 500 years ago. During the 1960s, large areas of forests were cut and planted with teak, resulting in subsequent increased hunting pressure and possible decline in population. Hunting ceased in 1977, and the population increased during the next few years (Blouch and Sumaryoto 1987). Present status of the population is unclear.

Field studies

Status and ecology (WWF 1979; Blouch and Sumaryoto 1987).

Conservation action to date

Bawean Island Nature Reserve (5,000ha) was established in 1979 and a management plan prepared (WWF 1979). The plan is now in need of revision. Management activities have included protection from hunting, controlled burning of grassy areas within forests, and thinning of teak plantations to encourage understory development (Blouch and Sumaryoto 1987).

Recommended conservation action

1. Reassess population status and make appropriate revisions to management plan. While the population was thought to be increasing during the early 1980s, its small size and insular nature leave it susceptible to hunting and environmental catastrophe. Standardized and repeated population censuses, demographic surveys, and assessment of current hunting pressure are required.
2. Assess impact of deer on crops as this may have become a problem if effective protection has allowed the population to increase substantially. Community-based mediation with local conservation officials are recommended to find solutions and mitigate conflict.
3. Initiate a coordinated breeding program to address possible inbreeding deficiencies in the captive population.

Hog deer *Axis porcinus*

A. p. porcinus: Bhutan, Cambodia, China, India, Laos, Myanmar, Nepal, Pakistan, Sri Lanka (introduced), Vietnam

A. p. annamiticus (Indo-Chinese hog deer): Cambodia, Laos, Vietnam, China (Yunnan), Thailand (extinct)

CITES:

A. p. porcinus – Not listed

A. p. annamiticus – I

1996 IUCN Red List Category:

A. p. porcinus – LR(nt)

A. p. annamiticus – DD

Distribution and status in the wild

The species is widely distributed throughout much of tropical Asia; from Pakistan in the west across northern India, Nepal, Bhutan, Bangladesh, southern Yunnan in China, and Myanmar, as far east as southern Thailand, Vietnam, Cambodia, and Laos (Boonsong and McNeely 1977). Thought to have been introduced to Sri Lanka (McCarthy and Dissanayake 1992). Introduced to Victoria, Australia (Moore and Maze 1990).

As lowlands are increasingly settled and cultivated, populations are declining and becoming more fragmented and isolated.

Bhutan: *A. p. porcinus* occurs in the lowlands of southern Bhutan, but its status is unknown.

- *Protected areas:* Mochu Wildlife Reserve, Royal Manas National Park.

Cambodia: No information.

China: Restricted to parts of Yunnan bordering Laos and Thailand (Ohtaishi and Gao 1990).

- *Protected areas:* No information.

India: *A. p. porcinus* found mainly in the terai grasslands along the Himalayan foothills and the flood-plains of the Ganga and Brahmaputra Rivers, from Punjab in the west to Arunachal Pradesh in the east (Tandon 1989; Q. Qureshi, pers. comm. 1995).

- *Protected areas:* Rajiv Gandhi (Orang), Bornadi, and Jaldapara Wildlife Sanctuaries; Corbett (200 animals), Dudwa (4,000–5,000), Keibul Lamjao, Rajaji, Kaziranga (8,000–9,000), and Keoladeo National Parks; and Manas Tiger Reserve (10,000) (Tandon, 1989; Q. Qureshi, pers. comm. 1995).

Laos: No information.

Myanmar: No information.

- *Protected areas:* Pidaung, Kahilu, and Hlawga Wildlife Reserves (Thein *et al.* 1990).

Nepal: *A. p. porcinus* is abundant in the terai but restricted largely to protected areas. Densities range from 0.1 per km² in riverine forest, to 16.5 per km² in savanna, and 35 per km² in grassland-flood-plains (Seidensticker 1976; Dhungel and O’Gara 1991).

- *Protected areas:* Kanchanpur Sanctuary, Koshi Tappu Wildlife Reserve, Royal Karnali Bardia Wildlife Reserve, Royal Chitwan National Park (abundant), and Royal Sukla Phanta Wildlife Reserve (abundant).

Pakistan: *A. p. porcinus* is confined to isolated riverine grasslands along the Indus valley and its upper tributaries. The majority of the population occurs in the Indus River forest reserves of Sind Province, with small populations around the Indus mouth and to the north of Sukkur (Roberts 1977).

- *Protected areas:* Chashma Lake Wildlife Sanctuary, Head Islam/Chak Kotora Game Reserve (greatly reduced in number), Lal Suhanra National Park (reintroduced), Taunsa Barrage Wildlife Sanctuary, and possibly in Rasool Barrage Wildlife Sanctuary (WCMC 1992).

Sri Lanka: *A. p. porcinus* is restricted to largely cultivated landscapes within a 35km² area, between Ambalangoda and Indurawa on the southwest coast, and inland as far as Elpitiya (McCarthy and Dissanayake 1992).

- *Protected areas:* None. Continued survival of the species will depend on controlling hunting and maintaining traditional agricultural land use practices. The land is intensively cultivated and the establishment of protected areas within the range of the species will not be possible.

Thailand: *A. p. annamiticus* was formerly abundant in the Chao Phraya Basin during the early 20th century, but had

Hog deer (*Axis porcinus*).



C. McDougal/Tiger Tops Ltd

become extinct by the mid-1960s (Humphrey and Bain 1990).

Vietnam: *A. p. annamiticus* is thought to be close to extinction, having previously been widespread in the south (Ratajszczak 1991). Occurs at low densities in Daklak (Yokdon), Dong Nai (Langa River, Baria), Jalai Kontum (Sathay), and Lam Dong (Bao Loc) provinces (Dang Huy Huynh 1986). There are an estimated 200 in the Taynguyen Highlands of southern Vietnam (Dang Huy Huynh, pers. comm. 1990).

- *Protected areas:* Sathay Forest Reserve, Yok Don Sanctuary, and Nam Catheren National Park.

Past distribution and status

Formerly more widespread. Range included Bangladesh, but the species has probably disappeared from the Sundarbans (Salter 1984) and has not been reported from the tea gardens of Sylet District since the 1970s (M. Farid Ahsan, pers. comm. 1990).

Status in captivity

Country/State	Institution	Population structure	Total	Year Ref.
Thailand	Khao Kheow Open Zoo	41.27.19	98	ISIS 1993

For internationally held stocks see ISIS (1993).

Ecology and reproduction

Habitat and food preference: Prefers tall grassland, scrub, and cultivated landscapes in the vicinity of wetlands over closed canopy forest. Mixed feeders: diet includes young grasses, herbs, fruits, and browse (young leaves and shoots of shrubs). Occurs in scrub and cinnamon gardens in Sri Lanka, and causes considerable damage to home crops (McCarthy and Dissanayake 1992).

Average group size and dispersion pattern: In Chitwan, generally solitary or in pairs, although aggregations of up to 20 animals have been observed feeding on new shoots following fire (Dhungel and O’Gara 1991). In Kaziranga, aggregations of 40–60 animals have been seen on grazing grounds created by rhinoceroses (Q. Qureshi, pers. comm. 1995).

Movements: In Chitwan, essentially sedentary (Dhungel and O’Gara 1991), but in cultivated landscapes (Sri Lanka) movements are reported to be influenced by agricultural

seasons (McCarthy and Dissanayake 1992). They move into highland grasslands in response to monsoon flooding in India (Q. Qureshi, pers. comm. 1995).

Reproduction: Rut during September–October in Nepal and India and September–February in China. 1–2 fawns are born during April–May in Nepal and during April–October in China. Gestation period is 220–230 days (Dhungel and O’Gara 1991; Sheng and Ohtaishi 1993).

Uses

Subsistence: Traditionally valued for its meat and skin.

Commercial: None within its native distribution.

Causes of decline and present threats

Habitat destruction, hunting, and establishment of plantations in grasslands outside protected areas. Flooding may take heavy tolls, especially in the Brahmaputra flood plain (Q. Qureshi, pers. comm. 1995).

Field studies

Sri Lanka: Status survey (McCarthy and Dissanayake 1992).

Nepal: Ecological study in Royal Chitwan National Park (Dhungel and O’Gara 1991).

Conservation action to date

In India and Nepal, hog deer have benefited from conservation measures taken for rhinoceros and swamp deer, since they share wet grassland habitats with these and other threatened species (Q. Qureshi, pers. comm. 1995).

Recommended conservation action

A. p. porcinus

1. Status surveys: insufficient is known about the species status, with perhaps the exception of Nepal and parts of India where it is abundant in several protected areas. Potentially viable populations should be identified for each range country and appropriate conservation action implemented.
2. In Sri Lanka, where the species is restricted to privately-owned gardens, its future survival will depend

on the goodwill of the landowners. An educational extension program should be mounted, and the use of conservation incentives for land-owners explored, and further investigations should be made into the species' ecological requirements.

A. p. annamiticus

1. In Vietnam: conduct status survey and initiate a research program to determine habitat requirements and other ecological data for use as basis for future management throughout range.
2. Determine status, trends, and extent of threats in Laos, Yunnan and Cambodia.

Reporters: Md Farid Ahsan (Bangladesh), Dang Huy Huynh, Hoang Minh Khien, Tian Van Duc (Vietnam), Qamar Qureshi (India).

White-lipped or Thorold's deer *Cervus albirostris*

China – Tibet, Sichuan, Qinghai

CITES: Not listed

1996 IUCN Red List Category: VU(C1)

Distribution and status in the wild

Endemic to the Tibetan Plateau region. Presently occurs in fragmented populations in east Gansu, east Qinghai, eastern Tibet, east Xizang Zizhiqu, and west Sichuan (Ohtaishi and Gao 1990; Kaji *et al.* 1993). Distributed sporadically at low density. Some 2,000 animals estimated in Gansu and Qinghai, and 4,000 in Sichuan and Xizang

White-lipped or Thorold's deer (*Cervus albirostris*), Quinhai Province, China.



c. Oswald

Zizhiqu, Tibet Autonomous Region (Wu, pers. comm. 1990).

- *Protected areas:* Ja-Ling and West-Sea (Qinghai Province).

Past distribution and status

Previously ranged across much of the eastern Tibetan Plateau (Koizumi *et al.* 1993).

Status in captivity

Government deer farms were established during the 1970s and 1980s to supply the market and prevent poaching. Many had closed by the end of the 1980s due to overproduction by farms in New Zealand and elsewhere (prices in China dropped due to imports).

For internationally held stock see ISIS (1993). A North American studbook for red deer and white-lipped deer is maintained by Ryan Gulker, Sunset Zoological Park, Manhattan, Kansas. In 1996 the first edition was published, and an analysis of populations is expected in 1997.

Ecology and reproduction

Habitat and food preference: Occurs in montane grassland, and rhododendron and willow scrub from 4,000–5,000m (Koizumi *et al.* 1993; G. Schwede, pers. comm.). Diet is comprised mostly of grasses (Tatatsuki *et al.* 1988).

Average group size and dispersion pattern: Seasonally large herds (up to 200–300), and female families (Miura *et al.* 1989).

Movements: Sedentary with little altitudinal movement. In winter, it ranges in the vicinity of lakes and rivers when food availability is higher (Jia-Yan Wu, pers. comm.).

Reproduction: Calving between late May and early July (Koizumi *et al.* 1993; Yu *et al.* 1993) following a rut in October (Sheng and Ohtaishi 1993). Gestation estimated at 246 days (Yu *et al.* 1993).

Age at first reproduction in captivity: two years (hinds) and five years (stags) (Koizumi *et al.* 1993).

Uses

Subsistence: Hunted for meat, antlers, and other organs, which are used in traditional Chinese medicine (Koizumi *et al.* 1993).

Commercial: Bred for antler production on government farms.

Causes of decline and present threats

Competition with livestock and hunting are major threats throughout the range. Habitat conversion and fragmentation of populations are serious problems in Qinghai and Xizang provinces (Koizumi *et al.* 1993; Ohtaishi and Gao 1990).

Field studies

Work includes that of Miura *et al.* (1989 and 1993) on social organization and mating behavior, and Koizumi *et al.* (1993) and Kaji *et al.* (1993) on distribution and status.

Conservation action to date

Legally considered a First Ranked Protected Species in China. Ja-Ling and West-Sea (Qinghai Province) protected areas were created in 1987 by the Forest Department specifically for protection of the white-lipped deer. The Zenda region, which has religious significance and is protected by local people, is also a sanctuary for the species near monasteries.

Recommended conservation action

1. Identify viable populations and potential reserve areas.
2. Develop conservation education program in Zenda based upon local religious sentiment (Koizumi *et al.* 1993).
3. Initiate long-term ecological studies to determine conservation requirements including competition with domestic livestock and impact of poaching on population.
4. Assess captive status of species and present status of government farms.

Reporters: Prof. Jai Yan Wu (China), George Schaller (USA).

Philippine spotted deer *Cervus alfredi*

Central Philippines – Visayan Islands

CITES: Not Listed

1996 IUCN Red List Category: EN(B1+2c)

Distribution and status in the wild

Endemic to the Western Visayan Islands (or Negros-Panay Faunal Region), central Philippines. Now restricted to the Mt. Madja – Mt. Baloy area of west Panay and a few scattered remnants of forest on Negros (Cox 1987; Oliver *et al.* 1992). A few individuals were reported to survive on Masbate in 1991, but the population there is almost certainly ‘functionally extinct’ (W. Oliver, pers. comm. 1994).

- **Protected areas:** Small populations in Mt. Canlaon National Park (22,650ha), North Negros Forest Reserve (c. 45,000ha), Mount Talinis/Lake Balinsasayao Reserve (c. 20,000ha), and the proposed West Panay Mountains National Park (c. 40,000ha).

Past distribution and status

Occurred throughout the central Visayan Islands including Guimaras and possibly Siquijor, Cebu, and Masbate, as well as on Panay and Negros (Oliver *et al.* 1991).

Status in captivity

Country/State	Institution	Population structure		Year Ref.
		Total		
Philippines (Negros Is.)	Silliman Univ.	6.8	14	Prelim. Studbook
	Negros Forest & Ecol. Fdn.	1.2	3	Mulhouse Zoo & Wm. Oliver
Philippines (Panay Is.)	W. Visayas State Univ.	6.6	12	Pers. Comm.
France	Mulhouse Zoo	6.5	11	Pers. Comm.
Germany	W. Berlin Zoo	1.1	2	Pers. Comm.

By 31 December 1994 the “World Herd” totalled 46 (25:21), of which nine females and nine males were captive bred (Oliver 1996).

Ecology and reproduction

Habitat and food preference: Dipterocarp rain forest (Cox 1987), but also frequents open grassy patches and secondary communities. Predominately a browser, but also a grazer (captive animals relish fruit).

Average group size and dispersion pattern: All local reports indicate its average group size of one to three individuals; mostly solitary males and females with single young.

Movements: None reported.

Time of calving: All year round in captivity. Young animals are reported to be captured in the wild at all times of the year.

Uses

Subsistence: In the past, it provided a source of meat for local people (Cox 1987). This species is still intensively hunted throughout its remaining range.

Commercial: Orphans of hunter-killed animals are often offered as pets.

Causes of decline and present threats

Has declined primarily as a result of habitat conversion (agriculture and logging) and hunting (Cox 1987; Oliver *et al.* 1991; Oliver 1992). These factors continue to operate. Some sub-populations are now so reduced in size as to be of doubtful viability.

Field studies

Status survey in 1985 (Cox 1987), and on Masbate in 1993 (Oliver, in prep.).

Conservation action to date

Philippine Spotted Deer Conservation Program set up in 1990 to establish an ex-situ 'World Herd' and to initiate a variety of other conservation related activities (e.g. a public education campaign and an annual series of conservation workshops). A new national park (Panay Mountains) was proposed for which a preliminary management plan was completed in 1987 (Oliver *et al.* 1991; Oliver 1992 and pers. comm.; Lernould 1993).

Recommended conservation action

1. Management of protected areas: Establish Panay Mountains National Park and implement management plan. Develop management plan for Mount Canlaon National Park on Negros and explore options for protection of other remnant populations. Provide training for relevant Filipino staff in park management techniques.
2. Assess genetic differences between insular populations on Panay and Negros.
3. Continue development of the public education campaign.

4. Monitor and control illegal captures and movement of spotted deer; assess status of privately-held captive stocks and continue attempts to access animals of known origin for a collaborative breeding program; develop and extend breeding program through dispersal of breeding stocks on loan to reputable (breeding loan signatory) institutions, which are also prepared to contribute resources and technical assistance for relevant in-situ conservation activities under the aegis of this "flagship" program. Extend these activities to other critically threatened Visayan endemic species and their habitats.
5. Integrate logging techniques with deer habitat requirements; integrate management of watersheds with deer management.

Reporter: W.L.R. Oliver.

Swamp deer or barasingha *Cervus duvauceli*

India, Nepal, Pakistan (extinct)

C. d. duvauceli (wetland barasingha): Nepal, India

C. d. branderi (upland barasingha): India

C. d. ranjitsinhi: India, Bangladesh (extinct)

CITES: I

1996 IUCN Red List Category:

C. d. duvauceli – VU(C1)

C. d. duvauceli – VU(C1)

C. d. branderi – EN(D1)

C. d. ranjitsinhi – CR(C2b)

Distribution and status in the wild

Present distribution of the barasingha is much reduced and fragmented, with an estimated minimum of 5,000 remaining in the wild, mostly in protected areas. Altitudinal range is between 100m and 300m. The northern subspecies *C. d. duvauceli* is the most numerous and occurs in several localities in the terai (lowlands) of southern Nepal and adjacent districts of Bahraich, Kheri, and Pilibhit in India. The eastern subspecies *C. d. ranjitsinhi* is restricted to a single population in Assam, northeastern India, and the central Indian sub-species, *C. d. branderi*, to a single population in Madhya Pradesh, India (Sankaran 1989).

India: At Dudwa National Park, Kheri District, Uttar Pradesh, India, the population of *C. d. duvauceli* has declined from 1,200–1,500 in 1976 to about 700 by 1993. The relict populations in the adjacent districts of Bahraich

and Pilibhit number only about 10–25 and 50–90 respectively, but Kishanpur Sanctuary holds about 400 animals (A. Singh, pers. comm. 1990; Qureshi and Sawarkar 1994). Kaziranga National Park in Assam, northeastern India had a population of about 756 *C. d. ranjitsinhi* in 1984, but this had declined to 350–500 by 1994 (Choudhury 1987; Qureshi and Sawarkar 1994). Kanha National Park, in east-central India (Madhya Pradesh), held a population of *C. d. branderi* of over 500 in 1986, an increase from 66 in 1966 (Khajuria and Sinha 1986). In 1994, the population was thought to number 450–550 (Qureshi and Sawarkar 1994). Further details of the Indian population (*C. d. duvauceli*), estimated at 3,500–4,000, are summarized in the report of the PHVA workshop (Qureshi *et al.* 1995).

- **Protected areas:** As above. A management plan for Dudwa is being prepared and Kaziranga has a management plan which needs updating. Protection is adequate in Kanha, as there is a plan for managing swamp deer which was updated for the period 1989–1999 (Kotwal and Panihar 1989). Improved management is needed in other protected areas.

Nepal: Two main populations of *C. d. duvauceli* are present in Nepal. Of these, Royal Sukla Phanta Wildlife Reserve contained the worlds largest population (around 1850) in 1993, an increase from around 900 animals in 1976 (Henshaw 1993). At least 34 animals are thought to be present in the Karnali-Bardia National Park in south-central Nepal (an increase from six in 1977) (Bauer 1990).

- **Protected areas:** As above.

Past distribution and status

Until the last century, swamp deer were widely distributed in areas of suitable habitat throughout the north Indian Gangetic Plain and the lowlands of the southern Himalaya. The range formerly extended eastward across the terai of southern Nepal through Assam as far as the Sunderbans. Swamp deer were present as far west as the River Indus, and as far south as the Godvari River area of east-central India (Sankaran 1989; Schaller 1967).

Status in captivity

In 1995 there were 74 (25:34:15) individuals of *C. d. duvauceli* in 10 Indian zoos, five of which had non-viable stock with adverse sex ratios. Lucknow Zoo had the largest (41) captive stock (Q. Qureshi *et al.* 1995). For internationally held stocks see ISIS (1993). The North American population is of unknown provenance, and may represent a mixture of subspecies.

Table 11. Status of *Cervus duvauceli* in captivity.

Country/State	Institution	Population structure		Year Ref.
		Total		
India/Bihar	Bajarang Zoo, Durbhanga	?	2	1995
	Sanjay Ghandi Zoo, Patna	?	2	1995
India/New Dehli	National Zoo, Dehli	4.6	10	1995
India/Karbataka	Mysore Zoo	2.2.3	7	1995
India/Punjab	Chhatbir Zoo, Chandighar	2.3	5	1995
India/Tamil Nadu	Mini Zoo, Courtalam		0	1995
India/Uttar Pradesh	Indira Park, Bijnor		0	1995
	Kanpur Zoo, Kanpur	7.4	11	1995
	Lucknow Zoo, Lucknow	9.12.10	31	1995
	IVRI, Bareilly		0	1995
	Indira Manoranjan Van Lakhimpur-Kheri	1.0	1	1995
	Kukrail	4.4	8	1995

Ecology and reproduction

Habitat and food preference: Barasingha inhabit flooded tall grassland and open sal (*Shorea robusta*) forest with a grass understory. The upland barashinga (*C. d. branderi*) occupies drier habitat. *C. duvauceli* is predominantly a grazing animal, but the wetland barasingha (*C. d. duvauceli*) is known to occasionally feed on aquatic plants (C.D. Schaaf, pers. comm. 1990). Aquatic plants also contribute significantly to the diet of *C. d. ranjitsinhi* during the monsoon and winter (Qureshi *et al.* 1994).

Average group size and dispersion pattern: Disperse in the wet season and congregate in large herds during the dry season, often in response to new growth following fire. Behavior during the wet season is uncertain as tall grass makes observation difficult (Henshaw 1991; C.D. Schaaf, pers. comm.). In Dudwa, mean group sizes during summer, monsoon, and winter were 32, 13, and 7 respectively; congregations of up to 250 individuals have been seen (Qureshi *et al.* 1994).

Movements: Move seasonally in search of food and drinking water (Henshaw 1991), and in response to flooding during wet season (Qureshi *et al.* 1994).

Reproduction: May–July in Nepal and north-central India (Schaller 1967).

Uses

Subsistence: Exploited by local people for meat which fetches a high price (C.D. Schaaf, pers. comm.).

Commercial: Primarily for meat in local markets, although swamp deer meat is considered less palatable than the meat of hog deer and chital (Qureshi *et al.* 1994). The hide is used to manufacture whips and other items (A. Singh, pers. comm.).

Causes of decline and present threats

Habitat has been reduced as a result of agricultural encroachment, reclamation of wetlands, grass and timber cutting, and illegal gathering of fuelwood and other resources in reserves by local people. Poaching is a significant factor (C.D. Schaaf; A. Singh, pers. comm. 1990).

Field studies

Research has been carried out in Sukla Phanta Wildlife Reserve (e.g. Ellenburg and Bauer 1988; Henshaw 1991 and 1993; Schaaf 1978), Karnali-Bardia National Park (e.g. Dinerstein 1980), Dudwa National Park (e.g. Schaaf and Singh 1976; Singh 1982; Qureshi *et al.* 1994; Qureshi and Sawarkar 1994), and Kanha National Park (e.g. Martin 1977). There has been little work in Kaziranga National Park.

Swamp deer or barasingha (*Cervus duvauceli*), India.



WWF-Canon/Martin Harvey

Conservation action to date

A PHVA (Population and Habitat Viability Assessment) workshop was conducted at the Wildlife Institute of India in July 1995. In Kanha National Park, conservation activities have included dispersal of tigers away from main grazing areas, control of poaching, cessation of grass burning, creation of water reservoirs, and reduction in cattle numbers (Khajuria and Sinha 1986). Translocation of villages from the park has significantly extended swamp deer habitat and protected their traditional fawning and rutting grounds (Qureshi *et al.* 1994).

Royal Sukla Phanta Wildlife Reserve: The park has been enlarged from about 60km² to some 300km².

Recommended conservation action

1. Determine population sizes and trends, and assess the extent and condition of available habitat.
2. Implement the recent management recommendations made for the Dudwa population, which include providing protection for the animals when they move out of the park during the monsoon and winter, and regulating the annual burning of grasslands.
3. The Kaziranga population has received little study and urgently requires research to determine status and ecological requirements.
4. A cooperative effort between India and Nepal is needed to improve management of the protected areas located along the border. This will require cooperation of local people, whose assistance must be sought

through active involvement in the conservation planning process.

5. Strengthen existing protected areas management where inadequate, and formulate new and revise old management plans.
6. To reduce poaching: seek alternative subsistence schemes for the local people, develop conservation education projects, and increase law enforcement if necessary.
7. Strengthen all measures necessary to maintain in-situ populations. Develop an international conservation program for barasingha in collaboration with Nepal (Qureshi *et al.* 1995).

Reporters: T.M. Maskey, C.D. Schaaf, Arjan Singh and Q. Qureshi.

Red deer *Cervus elaphus*

- C. e. barbarus* (Barbary stag or Atlas deer): Algeria, Tunisia, Morocco (extinct)
- C. e. corsicanus* (Corsican red deer): Corsica (extinct), Sardinia (feral?)
- C. e. bactrianus* (Bactrian or Bukhara deer): Afghanistan, former USSR
- C. e. yarkandensis* (Tamrin red deer or Yarkand stag): China
- C. e. hanglu* (Hangul or Kashmir deer): India
- C. e. wallichii* (Tibetan red deer or Shou): China, Nepal (extinct)
- C. e. affinis*: China, Bhutan
- C. e. macneilli* (McNeill's deer or Sichuan red deer): China
- C. e. alashanicus* (Alashan wapiti): China

CITES:

- C. e. hanglu* – I
- C. e. bactrianus* – II
- C. e. barbarus* – III

1996 IUCN Red List Category:

- C. e. affinis* – DD
- C. e. alashanicus* – DD
- C. e. bactrianus* – VU(D1)
- C. e. barbarus* – LR(nt)
- C. e. corsicanus* – EN(D1)
- C. e. hanglu* – EN(D1)
- C. e. macneilli* – DD
- C. e. wallichii* – DD
- C. e. yarkandensis* – EN(A1a)

Distribution and status in the wild

The red deer is widely distributed, from western Europe and northern Africa as far as continental East Asia and

eastern North America (Whitehead 1993). In addition, the European and North American subspecies have been introduced to Argentina (Isla de los Estados) and New Zealand.

Afghanistan: *C. e. bactrianus* was present along the northern border with the former USSR in the early 1980s (Flint *et al.* 1989). Some 42 animals were present in Ajar Valley Wildlife Sanctuary during the same period, following their reintroduction (IUCN 1993). Present status is unknown.

- *Protected areas:* As above.

Algeria: *C. e. barbarus* persists in the Annaba, Bouchegouf, and El-Kala regions, where it is restricted to the Beni-Salah, Ben Abed, and El-Kala forests (DSG 1988). The total number of animals in the mid-1970s was reported to be 400–600 (Halisse 1975), and by the late 1980s reached around 2,000 animals (Dolan 1988).

- *Protected areas:* El Ouberira El Kala Reserve.

Bhutan: *C. e. affinis* may still be present (Ohtaishi and Gao 1990; DSG 1983).

- *Protected areas:* No information.

China: Some eight subspecies of red deer are present in China, of which five have threatened status: *C. e. yarkandensis* had a declining population of about 4,000–5,000 in 1991, scattered along the Tarim and Karakax rivers, central Xinjiang Province (Gu Jinghe 1991); *C. e. wallichii* was thought to be present in southeastern Tibet; *C. e. macneilli* occurs in western Sichuan Province and eastern Tibet, where its status is unknown; *C. e. alashanicus* occurs in the Alashan Mountains of southeastern Inner Mongolia (Ohtaishi and Gao 1990). A recent survey by Schaller *et al.* (1996) suggests that *C. e. affinis* is confined to just a few localities in southeastern Tibet along the headwaters of the Subansiri River and Yarlung Tsangpo, which holds the largest known population of at least 110–125 (near Zhengi Village).

- *Protected areas:* No information.

Corsica (France): In 1987, less than 300 *C. e. corsicanus* (introduced from Sardinia) were held in a 30ha enclosure at Quenza, southern Corsica (Dolan 1988).

India: *C. e. hanglu* is endemic to Kashmir Valley, northern India. The only known viable population occurs in Dachigam National Park, Kashmir, where the population declined from 1,000–2,000 in the 1940s to less than 200 animals in the early 1970s. Numbers increased to 554 by 1984. This population is known to occasionally utilize the nearby Kishtwar National Park (IUCN 1993). Small populations were recorded during the 1970s in Overa-Aru Nature Reserve, Kashmir (seven animals) (Kurt 1978)



Jan Smielewski

Male hangul or Kashmir deer (*Cervus elaphus hanglu*), left, with female sambar (*Cervus unicolor*).

and in Gamgul Siahbehi Nature Reserve, Himachal Pradesh, where none have been reported in recent years (IUCN 1993).

- *Protected areas:* As above.

Mongolia: No information.

Sardinia (Italy): In 1983, the population of *C. e. corsicanus* totalled approximately 200, of which 80–120 occurred in the Oriental Sulcis and 60–80 in the southern Sarrabus (Dolan 1988).

Tunisia: The *C. e. barbarus* population was reported to have expanded considerably during the 1970s, with populations known in El Feidja, Ain Draham, and Tabarka regions (DSG 1988). The total population of ten animals in 1961 had increased to around 2,000 by the late 1980s. Much of this increase is attributed to the success of the 1966 reintroduction program at El Feidja, which has resulted in colonization of a 200km length of coastal Tunisia (Dolan 1988).

- *Protected areas:* In 1963, a 16,000ha forest reserve was established specifically for protection of *C. e. barbarus*.

Former USSR: During the early 1980s, an estimated 900 *C. e. bactrianus* existed along the Amu-Darya river valley, including the border with Afghanistan. This was an increase from around 600 in the early 1970s following reintroduction. (For a full account see Flint *et al.* 1989.)

- *Protected areas:* *C. e. bactrianus* occurs in Kizilkumskii Natural Reserve (c. 150 and decreasing), Amudaria Natural

Reserve (c. 10–15), Tiggrovaya Balka Nature Reserve (c. 250–300), and Kusavilisayskiy-Zakaznik Wildlife Sanctuary. It has been introduced to Ramit Nature Reserve (c. 200) and Sarikhosor Wildlife Sanctuary (c. 20) (Flint *et al.* 1989).

Past distribution and status

C. e. barbarus occurred in the north Africa region, including Morocco, as far south as the high plateau of Algeria (DSG 1988).

C. e. corsicanus occurred in mountainous areas of Corsica and Sardinia and had become extinct on Corsica by 1970 (Dolan 1988).

C. e. yarkandensis previously ranged from the Yerquiang River in western China to Luobupo in eastern China, and to the Cherchen River in the south (Gu Jinghe, pers. comm.).

C. e. hanglu previously ranged throughout the Kashmir Valley, India (Kurt 1978).

C. e. affinis occurred along the upper Yarlung Tsangpo Valley of the Subansiri River in southeastern Tibet, as well as northwestern Bhutan (Chunbi and Ha Valleys).

C. e. wallichi, with which *C. e. affinis* may be synonymous, have been found in the Langtang and Dolpo region of Nepal, but they are alleged to have come from just across the border in Tibet (Schaller *et al.* 1996).

C. e. bactrianus was distributed along the corridors of the Syr-Darya and Amu-Darya rivers in the former USSR, from the Aral Sea in the north, to northern Afghanistan in the south (Bannikov 1978).

C. e. macneilli occurs in the region of the former border between Tibet and China (Ohtaishi and Gao 1990). During the 1930s it was still present in eastern Tibet as far as the extreme western border with Szechwan Province (Allen 1940), and Schaller (pers. comm.) reports that it is still present.

Status in captivity

Table 12. Status of *Cervus elaphus* in captivity.

Country/State	Institution	Population structure		Year Ref.
		Total		
China	Deer farming projects	1.02	6000	1990 (Tarim River) Gu Jinghe (1991)

For internationally held stocks see ISIS (1993). A North American studbook for red deer and white-lipped deer (*C. e. bactrianus*, *C. e. barbarus*, *C. e. sibiricus*, and *C. e. macneilli*) is maintained by Ryan Gulker, Sunset Zoological Park, Manhattan, Kansas. In 1996, the first edition was

published, and an analysis of populations is expected in 1997.

Ecology and reproduction

Habitat and food preference: *C. e. yarkandensis* occurs in poplar woods, scrub, and marshland (Gu Jinghe, pers. comm.); *C. e. hanglu* is confined to moist temperate forest and feeds on woody species in winter and herbs in summer (Kurt 1978). *C. e. bactrianus* inhabits riverine scrub habitats (tugai) in arid environments and feeds on a variety of grasses, herbs, and shrubs (Bannikov 1978; Flint *et al.* 1989). *C. e. affinis* inhabits subalpine scrub and alpine pastures at 4,300–4,900m (Schaller *et al.* 1996). *C. e. macneilli* reportedly inhabits high altitude conifer and rhododendron forest, as well as meadowlands (Allen 1940; Schaller, pers. comm.).

Average group size and dispersion pattern: *C. e. yarkandensis* forms groups of 10–15 in summer and 20–30 in winter (Gu Jinghe, pers. comm.). *C. e. affinis* forms groups of two to nine, usually females with young, the largest observed being 55 (Schaller *et al.* 1996). *C. e. bactrianus*: females and the previous years offspring form groups of less than 10, while males may congregate in groups of up to 30.

Movements: *C. e. hanglu* are widely dispersed at higher altitudes during winter but congregate at lower elevations in the main Kashmir valley during spring. The population is reported to migrate to Kishtwar National Park during severe winters (Kurt 1978; IUCN 1993). *C. e. bactrianus* is generally sedentary, except during periods of flooding when animals move to higher ground (Bannikov 1978).

Reproduction: *C. e. yarkandensis* calves during June–July (Gu Jinghe, pers. comm.), *C. e. hanglu* in July–August, and *C. e. bactrianus* at the end of May to early June (Bannikov 1978). Gestation period is 233 days in captive herds (Kelly *et al.* 1987). Sexual maturity is reached in approximately 1.5 years (Sheng and Ohtaishi 1993).

Uses

Subsistence: In China, *C. e. yarkandensis* is subject to heavy poaching (Gu Jinghe, pers. comm.). In India, *C. e. hanglu* was intensively hunted until implementation of conservation measures in the late 1970s. *C. e. bactrianus* is heavily poached for food throughout its range in the former USSR.

Commercial: In China, antlers, tendons, unborn fawns, male reproductive organs, and tails from *C. e. yarkandensis* fetch a high price on local markets for use in traditional

Chinese medicine. Current market prices for these products are increasing rapidly. Young deer are sold as stud for deer farming projects. (Gu Jinghe 1991).

Causes of decline and present threats

Algeria and Tunisia: *C. e. barbarus* declined due to hunting, particularly during the Algerian War, and habitat degradation from forest fires (DSG 1988).

Corsica and Sardinia: *C. e. corsicanus* declined as a result of hunting (Dolan 1988).

China: *C. e. yarkandensis* diminished due to illegal hunting and capture of fawns (Gu Jinghe, pers. comm.). *C. e. wallichi* has declined predominantly as a result of hunting, but also due to pressure from pastoralism (Schaller *et al.* 1996).

India: *C. e. hanglu* declined primarily due to poaching, although high densities of domestic stock (primarily sheep) and human disturbance have also been contributing factors (Kurt 1978).

Afghanistan and former USSR: *C. e. bactrianus* is reported to have declined in the former USSR as a result of development of the Amu-Darya river valley (Bannikov 1978). In both the former USSR and Afghanistan, hunting, settlement, stock grazing, and reed burning have reduced available habitat (Petocz 1973).

Field surveys

Status surveys have been carried out on *C. e. barbarus* by E.J. van Alphen (1965) and by Halisse (1975); on *C. e. yarkandensis* in China by Chen Fuguan and Gu Jinghe; on *C. e. affinis* in southeastern Tibet by Schaller *et al.* (1996); and on *C. e. bactrianus* in Afghanistan by R. Petocz (Petocz 1973). Kurt (1976) and Mustafa Shah *et al.* (1983) have studied *C. e. hanglu* in Dachigam National Park, India.

Conservation action to date

India: *C. e. hanglu* was the subject of Project Hangul, initiated during the 1970s in response to population decline. A management plan for Dachigam National Park was developed (now in need of revision) and the population decline was reversed. A reintroduction program was underway for *C. e. bactrianus* during the late 1980s, but this has reportedly been abandoned due to political tension in the region. The Tibet Forest Bureau was planning a survey of *C. e. wallichi* in 1994/95 (Schaller, pers. comm.).

Recommended conservation action

C. e. corsicanus

1. Undertake status surveys and assess effectiveness of current protection measures.
2. Investigate establishment of captive breeding and reintroduction programs.
3. To reduce poaching: seek alternative subsistence schemes for the local people, develop conservation education projects, and increase law enforcement if necessary.

C. e. yarkandensis

1. Intensify research efforts and monitoring programs.
2. Improve management of the Tarim river corridor and establish protected areas specifically for *C. e. yarkandensis*.
3. Prohibit capture of fawns from wild and strengthen enforcement measures. Seek alternative subsistence schemes for the local people and develop conservation education programs.

C. e. hanglu

1. Census present population to determine current status.
2. Initiate ecological research to determine population distribution, habitat requirements, and extent of hunting and human use of the park.
3. Update management plan on the basis of above research.
4. Exclude domestic stock from protected areas with physical barriers and law enforcement, reduce numbers of livestock, and improve livestock management through farmer education demonstration projects.

C. e. wallichii

1. Confirm or refute reports that it no longer occurs in southwestern Tibet and the vicinity of Nepal.
2. Determine its status in Bhutan.

C. e. affinis

1. Determine status in Bhutan and in the region of Zhengi.
2. Support the Tibet Forest Bureau to protect the Zhengi population in cooperation with local people through law enforcement and the establishment of a reserve. (Schaller *et al.* 1996).

Reporter: Gu Jinghe.

Eld's deer *Cervus eldi*

- C. e. eldi* (Sangai or Manipur brow-antlered deer): India
C. e. thamin (Thamin or Burmese brow-antlered deer): Myanmar, Thailand
C. e. siamensis (Thailand brow-antlered deer): Cambodia, China, Laos, Thailand, Vietnam

CITES: I

1996 IUCN Red List Category:

- C. eldi* – VU(A2c)
- C. e. eldi* – CR(B1+2c, C2b)
- C. e. siamensis* – DD
- C. e. thamin* – LR(nt)

Distribution and status in the wild

Eld's deer is distributed across south and east Asia, but occurs as three geographically isolated and taxonomically distinct populations. *C. e. eldi* is confined to a single small population at the southern end of Loktak Lake in Manipur, India; *C. e. thamin* occurs in central Myanmar and adjacent areas of western Thailand; *C. e. siamensis* is found in two areas of Hainan Island, China and in Thailand, Vietnam, Laos, and Cambodia, where its status is unknown.

Cambodia: There are reports that *C. e. siamensis* is still relatively common in parts of the country (Thouless 1987).

- *Protected areas:* No information.

China: By the 1970s the Hainan population of *C. e. siamensis* had declined to some 40 animals in Dong Fang and Bai Sha Counties. It increased by 1991 to 346 animals, of which 261 range within Datian Nature Reserve, West Hainan (Yuan *et al.* 1993).

- *Protected areas:* As above.

India: *C. e. eldi* was thought to be extinct in the early 1950s but was subsequently rediscovered. By 1975, the only remaining wild population had declined to 14 animals in the swamps of Loktak Lake, Manipur. The population was reported to have increased to about 137 by 1994 (Singsit 1994), but 42 were counted during an aerial survey

Manipur brow-antlered deer (*Cervus eldi eldi*), India.



WWF/Ranjitsinh

in 1995, when no more than 25% of this total are thought to have been detected (Ranjitsinh 1996).

- *Protected areas:* Entire population occurs within Keibul Lamjao National Park, Manipur.

Laos: No information.

Myanmar: *C. e. thamin* was still relatively widespread and abundant during the mid-1980s on the plains of central and northern Myanmar. Its range centers on the Irrawaddy Plain, including the Pegu or Sittang Plain to the east. It is said to be present to the southeast, along the Thai border (Salter and Sayer 1986), and along the western border with Bangladesh (Boonsong and McNeely 1977), but these records are doubtful. Local distribution is becoming increasingly fragmented (7 areas) and the population is probably decreasing as a result of habitat conversion (Salter and Sayer 1986; Aung, M., pers. comm. 1996).

- *Protected areas:* Kyatthin and Shwesettaw Wildlife Sanctuaries hold the largest populations. In 1995 and 1996, the Kyatthin W.S. population was estimated by the line transect method to be 4.1 and 4.7 deer per km² respectively. This translates to a total population of about 500 deer (Aung, M., pers. comm.).

Thailand: *C. e. thamin* occurs along the Thai-Myanmar border (Salter and Sayer, 1986).

- *Protected areas:* Reportedly in Nam Nao National Park and Phu Khieo and Huai Kha Khaeng Wildlife Sanctuaries (WCMC 1992).

Vietnam: Confined to Phyun, Jalai Kontum, Dalak, Lam Dong, and Dong Nai provinces, south-Vietnam (Dang Huy Huynh 1990 and pers. comm.; Ratajszczak 1991).

- *Protected areas:* Reported as present in Nam Bai Cat Tien National Park, Bu Gia Map and Yok Don Nature Reserves, (Ratajszczak 1991), Ngoc Linh Nature Reserve (WCMC 1992), and Sathay and Tay Son forest reserves.

Past distribution and status

Eld's deer was formerly more widely distributed across much of south and east Asia, from the Manipur region of northeastern India through Myanmar, Thailand, and Indo-China, to the island of Hainan in the east (Salter and Sayer 1986).

Status in captivity

A total of 97 animals were held in 15 Indian zoos in December 1992 – a slight decline from over 100 in the mid-1980s (Decoux 1993). By 1994, 14 zoos held 107 animals (Sharma 1994). The population is probably inbred

Table 13. Status of *C. e. eldi* in captivity.

Country/State	Institution	Population structure		Year Ref.
		structure	Total	
India	Hyderabad Zoo	2.5.0	7	1994 Sharma
	Guwahati Zoo	3.5.0	8	1994 Sharma
	Dehli Zoo	10.27.0	37	1994 Sharma
	Ahmedabad Zoo	0.3.0	3	1994 Sharma
	Mysore Zoo	2.1.0	3	1994 Sharma
	Trivandrum Zoo	1.1.0	2	1994 Sharma
	Bhilai Zoo	2.1.0	3	1994 Sharma
	Nandankanan	0.1.0	1	1994 Sharma
	Chatbir Zoo	2.3.0	5	1994 Sharma
	Jaipur Zoo	1.0.0	1	1994 Sharma
	Madras Zoo	2.2.1	5	1994 Sharma
	Kanpur Zoo	4.4.0	8	1994 Sharma
Lucknow Zoo	1.1.0	2	1994 Sharma	
Calcutta Zoo	5.4.13	22	1994 Sharma	

Table 14. Status of *C. e. siamensis* in captivity.

Country/State	Institution	Population structure		Year Ref.
		structure	Total	
Vietnam	Institute of Biology	0.0.1	1	?
	Ho Chi Min Zoo	2.0.0	2	?
China	Kwangtung Zoo	?	1	?

Table 15. Status of *C. e. thamin* in captivity.

Country/State	Institution	Population structure		Year Ref.
		structure	Total	
Myanmar	Rangoon Zoo	19.16.0	35	Decoux 1993
Thailand	Khao Kheow	19.7.0	26	ISIS 1993
	Bangkok Zoo	9.15.5	29	Decoux 1993
	Bangphra	1.0.0	1	Decoux 1993
	Phu Khieo Wildlife	?	?	DSG 1989
Singapore	Singapore Zoo	6.3.0	9	ISIS 1993

as all are descended from two founder pairs (Walker and Marimuthu 1991). For internationally held stocks of Eld's deer see ISIS (1993). International studbook holder is Dr J.P. Decoux, Center Informatique du Museum, 57 Rue Cuvier 75231, Paris 5, France. North American Regional Studbook is maintained by C. Wemmer and M. Rodden, Conservation and Research Center, 1500 Remount Road, Front Royal, VA 22630, USA.

Ecology and reproduction

Habitat and food preference: *C. e. eldi* inhabits an area of floating vegetation known as phumdi, where its

diet includes grasses (Singh 1983). *C. e. thamin* and *C. e. siamensis* frequent lowland valleys and plains, avoiding dense forest and coastal areas (Salter and Sayer 1986).

Average group size and dispersion pattern: Stags are generally solitary except during the rut, while hinds congregate throughout most of the year (Gee 1961; Myint Aung, pers. comm. 1996).

Movements: In Keibul Lamjao National Park, *C. e. eldi* is thought to move from the phumdi to island hillocks during periods of flooding (Green 1990).

Reproduction: In China, the rut is during February–June, with a single fawn born from September to January. In India, calving occurs from mid-October to the end of December. Gestation period is between 237 and 240 days, and sexual maturity is reached at approximately 1.5–2.0 years (Wemmer and Grodinsky 1988).

Uses

Subsistence: *C. e. thamin* is exploited by local people for meat in Myanmar (Salter and Sayer 1986; U Myint Aung, pers. comm. 1997) and for meat and antlers in Vietnam (Dang Huy Huynh, pers. comm. 1990).

Commercial: *C. e. siamensis* reportedly fetches a high price in the zoo trade in Thailand (Salter and Sayer 1986). Antlers are sold on local markets in Vietnam (Dang Huy Huynh, pers. comm. 1990).

Causes of decline and present threats

In Manipur, the population has declined due primarily to wetland reclamation for grazing, cultivation, and fish farming (Green 1990). These factors are still operating. In Myanmar, decline is thought to be caused by habitat fragmentation and poaching (Salter and Sayer 1986; Aung, M., pers. comm. 1996). In Vietnam, populations are declining due to hunting and habitat conversion (Dang Huy Huynh, pers. comm. 1990).

Field studies

A status survey of *C. e. eldi* has been carried out annually in Keibul Lamjao National Park since 1975 (Ranjitsinh 1996), and research has been undertaken by Singh (1983). Population dynamics and activity patterns of the Hainan population have been studied by Yuan *et al.* (1993) and Song (1993), and *C. e. siamensis*

has been studied in Vietnam by Dang Huy Huynh. A status survey of *C. e. thamin* was carried out in 1983 in Myanmar (Salter and Sayer 1986), and an ecological study in Kyatthin Wildlife Sanctuary commenced early in 1995 (Wemmer, C. 1995). In Assam, a survey assessed the potential for reintroductions (Khan *et al.* 1993).

Past conservation action

In India, Keibul Lamjao National Park was gazetted in 1977 specifically to protect *C. e. eldi*. Projects have subsequently raised public awareness, and local support has been developed for conserving the Manipur subspecies. A Wildlife Institute of India proposal was made to establish a second free-ranging population in the 1980s (Khan *et al.* 1993), but was not implemented.

In Myanmar, Kyatthin and Shwesettaw Wildlife Sanctuaries were established specifically to protect *C. e. thamin* (Salter and Sayer 1986), but little management has been undertaken (Aung 1990). A number of reintroductions have taken place into enclosed protected areas, such as Hlawga Wildlife Park, using animals from Rangoon Zoo and the wild (DSG 1989). In 1995, an ecological study of radio-collared thamin was initiated in Kyatthin Wildlife Sanctuary by the Smithsonian Institution, and a community education project commenced later that year to raise local awareness of thamin and the wildlife sanctuary (Wemmer 1995). The Wildlife Division surveys the population annually using the line transect method.

In Thailand, *C. e. siamensis* was the subject of an abortive Smithsonian reintroduction program initiated in 1985. By 1989, progress was limited to construction of holding facilities at Phu Khieo Wildlife reserve (DSG 1989).

In China, a population viability analysis was undertaken to examine demographic and environmental (drought) challenges to the two enclosed populations at the Hainan Datian Nature Reserve (Song, Y.-L. 1996). Both populations were found to be vulnerable to increased mortality and drought.

Recommended conservation action

All remaining major populations:

1. Initiate studies of habitat utilization and population biology of remaining large wild populations, particularly in Myanmar, India, and Hainan.
2. Assess and implement options for sustained or alternative income/resources for local communities living near protected areas and unprotected habitat harboring the species. Develop community forests near reserves to reduce human impact on protected habitat.

3. Provide guidance to cooperative captive breeding programs existing in range countries (Myanmar, Thailand, India). Develop a protocol for exchange of genetic stock, and proper management and care of captive stocks.

C. e. eldi

1. Develop and implement a management plan for Keibul Lamjao National Park: give priority to long-term conservation by enforcing strict protection of core areas and incorporating buffer zones. Improve habitat quality (including management of Lake Loktak).
2. Investigate options for possible genetic and demographic management of the existing population to maintain maximum genetic heterozygosity.
3. Assess health status of wild population and institute measures to exclude future contact with domestic livestock.
4. Evaluate the earlier Indian proposal to establish a second wild population of *C. e. eldi* in Assam.

C. e. thamin

A number of proposals have been made (Aung 1990), including the following:

1. Determine distribution and status throughout the remaining habitat in the central dry zone. Continue ecological studies with emphasis on social organization, feeding and population ecology, migration, and habitat and corridor use.
2. Evaluate adequacy of existing protected areas; identify and mitigate threats to resident deer populations; seek alternative subsistence schemes for the local people; recommend management options to secure populations in reserve and unclassed forests.
3. Develop and implement a revised management plan for Kyatthin and Shwesettaw Wildlife Sanctuaries. Enforce strict protection of core area, incorporate buffer zones in the form of community forest projects, and provide alternate sites and necessary resources for village translocation and rural development.
4. Train wildlife division staff and fortify skills of wildlife officers in conservation, education, and community relations.

C. e. siamensis

1. Increase carrying capacity and population size, and reduce mortality of the two Hainan populations. Manage the populations for genetic mixing.
2. Create new populations in suitable habitat with adequate protection (Song, Y.-L. 1996).

Reporters: Dang Huy Huynh (Vietnam), K.S. Singh (India), U Myint Aung (Myanmar).

Philippine deer *Cervus mariannus*

Philippines – Luzon, Mindoro, Samar, Leyte, Mindanao, and Basilan Islands

Introduced: Caroline, Mariana, and Bonin Islands

C. m. barandanus: Mindoro

C. m. nigricans: Mindanao

CITES: Not listed

1996 IUCN Red List Category: DD

Distribution and status in the wild

Endemic to the Philippines, and rather widespread though patchily distributed, with the largest populations located on Luzon, Mindanao, Samar, and Leyte (Oliver, Cox and Dolar 1991). No survey data available, but Oliver *et al.* (1991, p. 199), report that “*C. m. barandanus* is at some risk over its restricted range in Mindoro,” and that the status of *C. m. nigricans* in lowland Mindanao merits investigation. Overall, the species is not considered seriously threatened throughout its range, but wild populations are definitely at risk. Hybridization with *Cervus alfredi* has also been reported (ibid).

Past distribution and status

Probably more extensively distributed in the past. Now extinct on Bohol.

Ecology and reproduction

No information reported.

Uses

Rural communities hunt the species for meat, hides, and trophies.

Causes of decline and present threats

Villamor (1991) reports that like the other two species of endemic Philippine deer, *C. mariannus* “is at risk due to unabated and alarming rate of deforestation and habitat destruction in most parts of the country; continued and intense hunting pressures; and the laxity by which government regulations are enforced.”

Field studies

None known.

Conservation action to date

Captive breeding of this species was advocated by the Ecosystems Research and Development Bureau (ERDB) as a means of supporting rural communities. A large herd mixed with domestic stock is maintained on a ranch in Batangas, medium-sized deer farms (30–40 animals) exist in the Bicol region, and small backyard farms (3–5 animals) are found in Luzon. It is not known to what extent these initiatives have mitigated threats to wild populations.

Recommended conservation action

1. Initiate a survey of Philippine deer populations on major islands to determine abundance, and the nature and extent of threats. Concentrate efforts on protected areas or regions of suitable natural habitat.
2. Re-examine the success of deer farming initiatives in selected areas to determine direct and indirect effects on local populations of Philippine deer.
3. Conduct a field investigation of species in an undisturbed population, preferably within a protected area.
4. Collect biological materials for an investigation of the relationship of the species to other endemic Philippine deer and Asian species of *Cervus*.

Reporter: William L.R. Oliver.

Sika deer *Cervus nippon*

- C. n. mantchuricus* (Manchurian sika): former USSR
C. n. mandarinus (North China sika) China
C. n. grassianus, *C. n. sichuanicus* (Shansi sika): China
C. n. yesoensis (Hokkaido sika): Japan
C. n. taiouanus (Formosan or Taiwan sika): Taiwan
C. n. pseudaxis (Vietnamese sika or Tonkin): Vietnam
C. n. kopschi, *C. n. aplodontus* (South China or Kopschi sika): Japan
C. n. keramae (Ryukyu or Kerama sika): Japan
C. n. pulchellus: Japan – Tsushima Is.

CITES: Not listed

1996 IUCN Red List Category:

- C. n. mantchuricus* – DD
- C. n. mandarinus* – CR(D1)

- C. n. grassianus* – CR(C2a)
- C. n. sichuanicus* – EN(D1)
- C. n. yesoensis* – DD
- C. n. taiouanus* – CR(D1)
- C. n. pseudaxis* – CR(D1)
- C. n. kopschi* – EN(D1)
- C. n. aplodontus* – DD
- C. n. keramae* – CR(C2a)
- C. n. pulchellus* – DD

Distribution and status in the wild

The sika deer is distributed across east Asia, from eastern China in the west to Japan and Korea in the east, and from the extreme eastern tip of the former USSR in the north to southeastern China. Introduced to Europe, North America, and New Zealand (Whitehead 1993).

China: Six subspecies of sika are present in China of which three are threatened and one, *C. n. mandarinus*, is probably extinct. There are 400–500 *C. n. sichuanicus* in the extreme north of Sichuan and in southern Gansu Province. *C. n. kopschi* occurs as five isolated small populations: in the Tianmu Mountains region of northern Zhejiang (less than 30 animals); in southern Anhui (70–100); near the border with Jiangsu, in Pengze, Jiangxi (150 animals); in southern Guangxi; and possibly in northern Guangdong. *C. n. grassianus* occurred in two separate and declining populations in western Shanxi but has not been reported for some years and may now be extinct (Ohtaishi and Gao 1990; Sheng Helin and Zhang Endi, pers. comm. 1990).

- *Protected areas:* *C. n. sichuanicus* occurs in Tiebu Nature Reserve.

Japan: *C. n. keramae* was introduced to the Kerama Islands from the Japanese mainland during the 17th century, and is reported to have subsequently developed as an insular form (IUCN 1972). In October 1995, the Brock count method yielded estimates on Yakabi Jima (46), Fukachi (7–10), Geruma (47), and Aka (130). A total of 230 was not considered viable. These numbers are similar to those reported previously (Anon. 1990).

- *Protected areas:* No information.

Taiwan: *C. n. taiouanus* is endemic to Taiwan. Extirpated by 1969 and reintroduced to Kenting National Park in 1988 (Green 1989).

- *Protected areas:* As above.

Former USSR: No information.

Vietnam: *C. n. pseudaxis* may now be extinct in the wild. In 1990, two to four animals were reported from the western Nghe Tinh Mountains (Dang Huy Huynh *et al.* 1990).

- *Protected areas*: Cuc Phuong National Park and Cat Ba National Park (captive populations) (Dang Huy Huynh *et al.* 1990).

Past distribution and status

C. n. mandarinus probably ranged across much of northeastern China, however, by 1918 it occurred in the wild only in the Imperial Hunting Grounds, north of Tung Ling, and in Wei-ch'ang region (both in Chihli Province). By the mid-1930s, its range had contracted further to northeastern Chihli (IUCN 1972).

C. n. grassianus ranged throughout western Shanxi Province, China (Ohtaishi and Gao 1990).

C. e. taiouanus was widely distributed throughout Taiwan (Green 1989).

C. n. pseudaxis was recorded from Caobang, Quang Ninh, Thanh Hoa, Hanoi, and Nghe Tinh districts of Vietnam (Dang Huy Huynh *et al.* 1990).

C. n. kopschi ranged from the Yangtze River Basin eastward to the coast, and south as far as northern Kwangtung Province (IUCN 1972).

Status in captivity

For internationally held stocks see ISIS (1993). The International Studbook for the Vietnamese Sika deer is maintained by Klaus Rudloff (Tierpark Berlin – Friedrichsfelder, Germany).

Table 16. Status of *Cervus nippon* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
China	farms	?	300,000	1990 Ohtaishi and Gao
	Kunming Zoo	?	10	1990 Zhang Endi; pers. comm. 1994
	Wuhan Zoo	?	10	"
	Guangzhou Zoo	?	16	"
	Chendu Zoo	?	9	"
	Shijiazhuang Zoo	?	1	"
	Nanchang Zoo	4.0.0	4	"
	Yinchuan Zoo	?	1	"
	Hangzhou Zoo	?	15	"
	Nanning Zoo	?	7	"
	Nanjing Zoo	?	10	"
	Lhasa Zoo	?	15	"
	Shenyang Zoo	?	8	"
	Haikou Zoo	?	1	"

Table 17. Status of *C. n. pseudaxis* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
Vietnam	Cuc Phong National Park	?	70–80	1990
	farms	?	3000*	1990
	Ho Chi Minh Zoo	?	8	1990**
	Cat Ba National Park	?	?	1990**

* Some are possibly hybrids between *C. n. pseudaxis* and *C. n. hortulorum* (Ratajszczak 1990). Only known pure bred population is in Cuc Phong National Park (DSG 1991). Ten animals (6.4) were sent to Poland in 1991 under the aegis of the Vietnamese Sika Breeding and Conservation Program (Ratajszczak and Smielowski, undated).
 ** (Dang Huy Huynh *et al.* 1990).

Table 18. Status of *C. n. taiouanus* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
Taiwan	Taipei Zoo	?	?	?
	farms	?	20 000	1989 Green
	Chin-Men Islands	?	?	1989 Green
	Lu-Tao Island	?	?	1989 Green

* Taipei Zoo stock is considered genetically pure, with no known hybridizations (Green 1989).
 ** Most are hybrids with *C. n. nippon* or *C. unicolor swinhoi* and are raised for antler velvet.

Formosan or Taiwan sika (*Cervus nippon taiouanus*).



WWF-Canon/D.R. McCullough

Ecology and reproduction

Habitat and food preference: In Vietnam, diet of *C. n. pseudaxis* includes browse and fruits (Dang Huy Huynh, Tran Van Duc, and Hoang Minh Khien, pers. comm.). In Taiwan, *C. n. taiouanus* inhabited open forests and grasslands of valley bottoms and foothills below 300m (McCullough 1974; Horng-jye Su, undated). *C. n. mandarinus* and *C. n. grassianus* probably occurred in upland forests (IUCN 1972). *C. n. keramae* favors lowland forests and plains (WWF 1984).

Average group size and dispersion pattern: In Vietnam, *C. n. pseudaxis* group size was 5–30 animals (Dang Huy Huynh, Tran Van Duc, and Hoang Minh Khien, pers. comm.). In China, *C. e. sichuanicus* forms large aggregations during May–August (Sheng Helin and Zhang Endi, pers. comm.).

Movements: In Vietnam, *C. n. pseudaxis* was thought to be primarily sedentary, although some seasonal movement took place depending on water availability (Dang Huy Huynh, Tran Van Duc, and Hoang Minh Khien, pers. comm.).

Reproduction: In China, rut occurs during September–November. A single fawn is born in May–July following a 210–213 day gestation. Sexual maturity is reached at 1.5 years. (Sheng and Ohtaishi 1993).

Uses

Subsistence: *C. n. pseudaxis* and *C. n. taiouanus* were hunted for meat and antler velvet for use in traditional medicine (Dang Huy Huynh *et al.* 1990; McCullough 1974). All subspecies of Sika have been hunted widely in China during the past 100 years (Ohtaishi and Gao 1990).

Commercial: In Vietnam, velvet from *C. n. pseudaxis* is traded in Hanoi and Ho Chi Minh City (Dang Huy Huynh, Tran Van Duc, and Hoang Minh Khien, pers. comm.).

Causes of decline and present threats

C. n. pseudaxis in Vietnam, and *C. n. mandarinus* and *C. n. taiouanus* in China, were probably extirpated as a result of hunting and habitat conversion for agriculture (Ratajszczak 1990; Dang Huy Huynh, Tran Van Duc and Hoang Minh Khien, pers. comm.; IUCN 1972). The small captive population of *C. n. pseudaxis* in Cuc Phuong National Park is presently threatened by poaching. In China, *C. e. sichuanicus* is threatened by poaching outside Tiebu Nature Reserve (Sheng Helin and Zhang Endi, pers.

comm. 1990). In Japan, *C. n. keramae* has been almost extirpated by hunting, and remains only on unoccupied islets where competition with feral goats and habitat change constitute serious threats (Anon 1990). Water pollution is a serious problem for the deer (WWF 1984).

Field studies

Numerous studies of *C. n. taiouanus* were carried out under the aegis of the Formosan Deer Restoration Project (e.g. habitat analysis [Horng-jye Su, undated]). Population ecology of *C. n. sichuanicus* was studied by Hu Jinchu and by Gao *et al.* (in press).

Conservation action to date

C. n. taiouanus: The Formosan Deer Restoration Project was initiated in 1984 to re-establish species in Kenting National Park (Green 1989).

C. n. sichuanicus is protected within Tiebu Nature Reserve, for which a management plan has been prepared and protection is adequate (Sheng Helin and Zhang Endi, pers. comm. 1990).

C. n. keramae: management activities have included filling of mine shafts, which posed threats to the deer, as well as construction of drinking water facilities (IUCN 1972).

C. n. pseudaxis: The Vietnamese Sika Breeding and Conservation Program was initiated in 1991 with a shipment of ten animals to Europe on breeding loan (Ratajszczak and Smielowski, undated).

Recommended conservation action

C. n. pseudaxis

1. Improve protection of Cuc Phuong National Park, with particular emphasis on control of poaching and development of a conservation education program.
2. Conduct a status survey in Nghetinh Province to determine presence of possible extant population.

C. n. taiouanus

1. Establish a peripheral hunting zone around Kenting National Park to benefit local people, and to minimize impact of deer encroaching into adjacent agricultural land.
2. Expand the area available to the existing free ranging population.
3. Plan, implement, and develop a fully integrated research program focused on the ecology of the free ranging population. Studies should include impact on vegetation and carrying capacity.

4. Develop a long-term strategy for management of Kenting National Park.

C. n. keramae

1. Survey status of present populations and undertake studies of existing habitat to determine extent of habitat degradation. Remove feral goats as an urgent priority.
2. Develop a management plan for habitat restoration.
3. Develop a captive breeding program using animals from surviving populations. Assess possible genetic differences between island populations.
4. Assess attitudes of local people toward conservation, initiate regional conservation education program, and increase law enforcement if necessary.

C. n. mandarinus and *C. n. grassianus*

1. Determine status in wild. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the deer.

C. n. kopschi

1. Secure protected habitat, and encourage community development options to mitigate threats.

Reporters: Dang Huy Huynh, Tran Van Duc and Hoang Minh Khien (Vietnam), Sheng Helin and Zhang Endi (China), M. Izawa (Japan).

Persian fallow deer
Dama dama mesopotamica

Iran, Iraq (extinct), Jordan (extinct), Israel (extinct), Lebanon (extinct)

CITES: Not listed

1996 IUCN Red List Category: EN(D1)

Distribution and status in the wild

The Persian fallow deer was thought to be extinct by the 1940s, but was subsequently rediscovered in Khuzistan Province, Iran during the 1950s (Davies 1982). The present population (including captive animals) does not exceed 250. There are thought to be two remaining extant wild populations; at Dez River Wildlife Sanctuary (probably fewer than 15 animals) and Karkeh River Wildlife Sanctuary (unreliable reports indicated about five animals in 1989 – a decline from around 20 in the mid-1980s) (G. Heidemann, pers. comm. 1994). There were a number of reintroduced populations as of March 1994 (G. Heidemann, pers. comm. 1994):

Dasht-e-Naz: About 100 animals are held in an enclosure. Management is inadequate, with high mortality and low reproductive rate. The animals are in poor physical condition.

Ashk Island/Lake Urumieh: Introduced from Dasht-e-Naz. Population is growing rapidly and was reported to be about 80 in December 1993. Some animals have left Ashk by swimming to other islands, indicating that carrying capacity has probably been reached. Survival on adjacent islands is likely to be poor due to lack of fresh water.

Kabuldagh Island/Lake Urumieh: Holds a small number of animals which may be the result of an introduction or immigration from Asht Island.

Shiri, Lavan, Kish Islands (Persian Gulf): Four animals from Dasht-e-Naz were introduced to Shiri, four to Lavan, and 3–4 to Kish. Most are reported to have died.

- *Protected areas:* As above.

Past distribution and status

Formerly ranged throughout Iran, Iraq, Jordan, Israel, and Lebanon.

Status in captivity

Country/State	Institution	Population structure	Total	Year Ref.
Iran	Pardisan Zoo	1.1.0	2	1994
	Semeskandeh Wildlife Refuge	?	<10	1994*
	Park Mellat (Tehran)	1.1.0	2	1994
	Miankotal/Fars**	?	?	1993

(Source: G. Heidemann pers. comm. 1994)
 * Probably *D. d. dama* x *D. d. mesopotamica* hybrids
 **Some 20 animals released to a 170ha enclosure near Shiraz, of which seven to eight remain. Enclosure is located within a 5000ha area, into which a release is planned. The project is said to be well managed (G. Heidemann, pers. comm. 1994).

For internationally held stocks see ISIS (1993). International Studbook Keeper: Klaus Ruloff, Tierpark Berlin, Friedrichsfelde, Am Tierpark 125, Berlin, Germany.

Ecology and reproduction

Habitat and food preferences: Wild population utilizes riparian forest thickets (McTaggart-Cowan and Holloway 1978).

Average group size and dispersion pattern: No information.



J. Dolan

Persian fallow deer (*Dama dama mesopotamica*).

Movements: No information.

Reproduction: Rut during August and early September and calve at the end of March to early April, following a gestation period of approximately 229 days (Chapman and Chapman 1975).

Uses

Subsistence: No information.

Commercial: No information.

Causes of decline and present threats

During the past, hunting and habitat conversion for agriculture were threats. There is now extensive habitat degradation in the Dasht-e-Naz and Semeskandeh enclosures and the animals were in poor condition in 1990.

Field studies

No information.

Conservation action to date

Iranian Persian Fallow Deer Project initiated during the mid-1970s to carry out breeding and restocking of protected areas.

Recommended conservation action

1. Strengthen protection and management of existing protected areas and identify suitable sites for re-establishment from Dasht-e-Naz and Semeskandeh populations; rehabilitate degraded habitats at Dasht-e-Naz and Semeskandeh and improve management; establish training program for Iranian staff in protected areas management, habitat rehabilitation, and captive management.
2. Survey and monitor existing wild and reintroduced populations and initiate ecological studies. Consider reintroductions to Dez and Karkeh Wildlife Sanctuaries.
3. Assist Iranian efforts to develop international captive breeding project. Provide technical assistance (communications equipment and vehicles) to Miankotal/Fars reintroduction and initiate research and monitoring program.
4. Genetic studies to determine purity of suspected hybrids.

Reporter: Gunther Heidemann.

Tufted deer *Elaphodus cephalophus*

E. c. cephalophus (tufted deer): China, Myanmar

E. c. michianus (Michie's tufted deer): China

E. c. ichangensis (Ichang tufted deer): China

E. c. fociensis (of doubtful taxonomic status): China

CITES: Not listed

1996 IUCN Red List Category: DD (all subspecies)

Distribution and status in the wild

Ranges through southern and southeastern China and northeastern Myanmar (Whitehead 1993).

E. c. cephalophus is the most westerly form, ranging from northeastern Myanmar into southern Szechwan and northern Yunnan provinces of southwest China; *E. c. ichangensis* occurs in central-southern China and northeastern Myanmar; *E. c. michianus* is restricted to coastal provinces of eastern China (Ohtaishi and Gao 1990).



Michie's tufted deer (*Elaphodus cephalophus michianus*).

J. Dolan

Past distribution and status

No information.

Status in captivity

For internationally held stock see ISIS (1993).

Ecology and reproduction

Habitat and food preference: Inhabits montane forest. Ranges between 300–800m in southeastern China; 1,500–2,600m in Sichuan and Gansu provinces; in western Sichuan up to about 4,750m (Whitehead 1993; Ohtaishi and Gao 1990).

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: Rut during September–December. The single fawn is born in May–July, following a gestation period of 210 days. Sexual maturity reached in approximately nine months (Sheng and Ohtaishi 1993).

Uses

Subsistence: Hunted by local people (Ohtaishi and Gao 1990).

Commercial: No information.

Causes of decline and present threats

No information.

Field studies

No information.

Conservation action to date

No information.

Recommended conservation action

Determine current status in the wild. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the species.

Père David's deer or milu *Elaphurus davidianus*

China

CITES: Not listed

1996 IUCN Red List Category: CR(D1)

Almost driven to extinction, Père David's deer (*Elaphurus davidianus*) was bred in captivity and has been re-introduced into parts of its former range.



C. Wemmer

Distribution and status in the wild

Probably extirpated in the wild around the end of the Han Dynasty (AD 220) (Cao 1978). Reintroduced in 1986 to a 1,000ha seasonally flooded coastal marsh site at Dafeng, Jiangsu Province. Population increased from 39 to over 120 by 1993 (Cao 1993).

Past distribution and status

The fossil record and ancient texts suggest Père David's deer was mainly restricted to southeastern China; ranges from Hainan in the south to Dafeng in the north, and inland as far as the Jiangnan Plain. Possibly introduced to Hainan Island (Ohtaishi and Gao 1990).

Status in captivity

For internationally held stocks see ISIS (1993).

Ecology and reproduction

Habitat and food preference: Original habitat thought to be coastal and riverine wetlands (Cao 1993).

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: April and May. In captivity, gestation is approximately 183 days (Wemmer *et al.* 1989).

Causes of decline and present threats

No information. The species became extinct in the wild due to habitat loss and hunting. The present reintroduced populations are contained within enclosures and subject to captive management.

Field studies

Dafeng herd: population dynamics (Liang *et al.* 1993), and feeding and reproduction (Liang 1991).

Conservation action to date

In 1986, 39 founders were reintroduced to Dafeng and 20 to the former Imperial Hunting Park near Beijing (DSG 1988). The populations have been growing continuously.

Recommended conservation action

Establish additional semi-wild populations when and where appropriate. Develop conservation education programs to raise conservation awareness among the local people and general public.

Chinese water deer *Hydropotes inermis*

China

H. i. inermis: China

H. i. argyropus: Korea

CITES: Not listed

1996 IUCN Red List Category:

H. inermis – LR(nt)

H. i. inermis – LR(nt)

H. i. argyropus – DD

Distribution and status in the wild

Occurs in southeast China and Korea, where its subspecific status is doubtful. Introduced to Britain and France.

China: *H. inermis* is distributed at low densities (0.5–3.2 individuals per km²) in two relatively small regions of southeastern China. The largest population occurs along the lower reaches of the Yangtze River and its associated lake system, where approximately 10,000 animals are present. Within this region, the coastal area of northern Jiangsu harbors 1200–1500 animals and the Zhoushan Islands 600–800 (Ohtaishi and Gao 1990). Populations also occur south of the Yangtze River in Jiangxi, Hubei, and Hunan provinces. Between 1,000 and 1,500 individuals are present in the Poyang Lake area of Jiangxi Province.

- *Protected areas:* Occurs in Poyang Lake Nature Reserve and Yancheng Nature Reserve, where around 1,000 animals are present in isolated subpopulations, each with less than 100 animals (Zhang 1994).

Korea: *H. i. argyropus* occurs in Korea, but its status is unknown.

- *Protected areas:* No information.

Past distribution and status

H. i. inermis once occurred in wetland areas across much of eastern China from Guangdong to Liaoning (Ohtaishi and Gao 1990).

Status in captivity

Table 20. Status of *Hydropotes inermis* in captivity.

Country/State	Institution	Population structure	Total	Year Ref.
China	Nanjing Zoo	?	10	1990
	Ningbo Zoo	?	5	1990
	Shanghai Zoo	15.15.0	30	1990
	East China Normal Univ.	?	40	1992
	Nanchang Zoo	?	2	1990
	Yancheng Nature Reserve	?	18	1994
Reference: Ohtaishi and Gao (1990).				

For internationally held stocks see ISIS (1993).

Ecology and reproduction

Habitat and food preference: Optimum habitat appears to be tall riverine grassland and wetlands, but hill forest and agricultural land are utilized during the wet season. The Chinese water deer is a selective grazer, feeding on wetland plants and other herbs (Sun Lixing, pers. comm.).

Average group size and dispersion pattern: Solitary or in small groups (Sun Lixing, pers. comm.).

Movements: Moves from wetlands to hill forests and agricultural land during floods (Poyang Lake area) (Xiaobing and Sheng, in press).

Reproduction: Rut during November to January and calves between early May and late June (Lixing, undated). Two to three offspring are common and up to six have been recorded (Whitehead 1993). Sexual maturity is reached at around nine months (Sheng and Ohtaishi 1993).

Field studies

Ecological and behavioral studies by Xiaobing and Sheng (in press) and Sheng and Lu (1987).

Uses

Subsistence: Exploited by local people for meat. Unweaned fawns are hunted for stomach contents which are reputed to be a traditional Chinese cure for indigestion in children. Hunting is carried out at night with dogs (Sun Lixing, pers. comm. 1990).

Commercial: No information.

Causes of decline and present threats

Poaching appears widespread, although it is not known to what extent this has affected the population. In Yancheng Nature Reserve, poaching is reported as severe, and there is high mortality during periods of flooding. Fawns have been bought from local people to establish and support the captive population, where the mortality rate is reportedly high (Zhang 1994).

Conservation action to date

Poyang Lake Nature Reserve has a management plan and is regularly patrolled. A small captive population has been established in Yancheng Nature Reserve, but the justification for this is unclear (Zhang 1994).

Recommended conservation action

1. Poyang Nature Reserve: Enlarge the reserve and improve its protection. The reserve covers only a small part of *H. inermis*' range in the Jiangxi region, and it is recommended that this be increased in size and that protection be extended to nocturnal patrols when the majority of poaching takes place.
2. Yancheng Nature Reserve: Establish habitat corridors to link small, isolated populations.
3. Strengthen existing protected areas management: increase staffing levels and improve communications and equipment supply; introduce anti-poaching patrols; develop community-based management strategies and an education program in response to human encroachment and poaching; and introduce training program for reserve staff in wildlife management techniques.
4. Create new protected areas (only a small proportion of the total population is currently protected).

Reporters: Sheng Helin, Zhang Endi, and Sun Lixin.

Giant muntjac *Megamuntiacus vuquangensis*

Cambodia, Laos, Vietnam

CITES: I

1996 IUCN Red List Category: DD

Distribution and status in the wild

This newly described genus and species (Tuoc *et al.* 1994; Schaller and Vrba 1996; Groves and Dawson 1997 *in*

press) was first recorded in Ha Tinh Province in north-central Vietnam and the adjoining areas in the Nakai plateau, Laos, (Evans 1995). Subsequent field surveys and examination of specimens have revealed a much wider distribution all along the Truong Son (Annamite) range of mountains that runs along the international boundaries between Vietnam and Laos, and the Central Highlands (Do Tuoc, *pers. obs.* 1995). A complete specimen, previously identified as *Muntiacus muntjac*, is housed in the collection of the Forest Protection Department in Dalai, southern Vietnam, although its origin is not clear. There have been no records to date of the species occurring north of the Truong Son range. One specimen (only frontlets) found in the Wildlife Protection Office, Phnom Penh in April 1996 (S. Dawson, *pers. obs.* 1996) suggested that this species could be found in Cambodia. Subsequent field surveys have confirmed its existence in the eastern province of Monduliri (Desai and Vuthy 1996).

The species appears to be widespread within its known range, although it remains vulnerable due to hunting and habitat destruction. Based on information from local hunters, the status of the species in Vietnam appears to vary between common and rare in most areas. In Vu Quang Nature Reserve, it is reported to be more common than *M. muntjac* in the evergreen forests above 600m, while in Phu Mat Nature Reserve it is said to be less common (Dawson 1995). In Laos, it is reported to be moderately common to rare depending on the condition of the forest (Schaller and Vrba 1996). In Cambodia, based on the proportion of trophies seen in Monduliri, it appears that *M. vuquangensis* is not as common as *M. muntjac*, although it is not rare (Desai and Vuthy 1996).

There have been only three field sightings – two females in Nakai-Nam Theun, Laos (Evans and Timmins 1995)

and an adult male in Vu Quang Nature Reserve (Dawson, *et al.* 1995).

- **Protected areas:** Phu Mat Nature Reserve, Nghe An Province (120,000ha) and adjacent Vu Quang Nature Reserve, Ha Tinh Province (60,000ha), north-central Vietnam, Phong Nha Nature Reserve (7,000ha), Bach Ma National Park (22,500ha), and Mom Ray Nature Reserve (45,000ha) in central Vietnam. There are four National Biodiversity Conservation Areas in the Annamite Mountains (775,000ha) including the Nakai-Nam Theun Conservation Area (c. 350,000ha), Phnom Nam Lyr Wildlife Sanctuary (47,500ha), and Phnom Prich Wildlife Sanctuary (222,500ha).

Past distribution and status

Unlike the sympatric bovid *Pseudoryx nghetinhensis* described from the same area, the giant muntjac does appear to have been reported in the literature before by a French hunter who found it in the Annamite range (now called Truong Son range), although it was described as a very large *M. muntjac* (de Monestrol 1925). It appears that the species was present in similar densities to the common muntjac during that time. There is no other record of its past distribution or status, although it probably occurred far south of the Truong Son range in evergreen and semi-evergreen forests.

Status in captivity

One male held in Lac Son, a private menagerie in Khammouane Province of Laos.

Ecology and reproduction

Habitat and food preference: Inhabits evergreen and semi-evergreen dipterocarp forests with a preference for primary forests, although they have been noted in second-growth areas in Vietnam and Laos (Tuoc *et al.* 1994; Schaller and Vrba 1996). Also reported from dry primary hill evergreen forests and degraded lowland semi-evergreen forests in Laos (Evans and Timmins 1995). The two areas in Cambodia where it is reported are comprised of a mosaic of moist to dry deciduous forests with some patches of evergreen (Desai and Vuthy 1996). The species has been noted within an altitudinal range of 500m to 1,200m.

Average group size and dispersion pattern: Based entirely on reports by local hunters, group size appears to average between one to two individuals, mostly solitary adult males and females, and females with single young.

Giant muntjac (*Megamuntiacus vuquangensis*).



G. Schaller

Movements: Not known.

Reproduction: Not known.

Uses

Subsistence: Provides a source of meat for local communities (Dawson 1995; Schaller and Vrba 1996). This species is still intensively hunted throughout its range.

Commercial: Orphans or young trapped animals are sold as pets, and frontlets as trophies locally. Antlers in velvet used for medicinal purposes.

Causes of decline and present threats

Species has probably declined due to habitat conversion (agriculture and logging), but hunting is still the biggest threat in all three countries (Tuoc *et al.* 1994; Dawson 1995; Schaller and Vrba 1996; Desai and Vuthy 1996).

Field studies

Status surveys carried out in Vietnam in 1994 (Dawson *et al.* 1995), Laos since 1994 (Evans and Timmins 1995; Schaller and Vrba 1996), and in Cambodia in 1996 and planned for 1997 (Desai and Vuthy 1996).

Conservation action to date

The species was proposed by Vietnam and accepted for protection under CITES Appendix in November 1994, immediately after its formal description. The description of the species from some of Vietnam's large protected areas has added to their conservation value and the government has taken steps to protect the species against hunting in these protected areas.

Recommended conservation action

1. Actively manage forested areas to deter fragmentation of habitat due to human activities, such as logging, road construction, hydroelectric power projects, and immigration. Management measures against hunting the species within protected areas to be implemented.
2. Further surveys are needed to determine more specific habitat requirements. Studies are needed to ascertain whether the species can withstand the present hunting pressure.
3. Monitor and control illegal captures of the species.

4. Initiate long-term ecological studies to determine its conservation requirements.
5. Initiate conservation education program for the public.

Reporter: Shanthini Dawson.

Musk deer *Moschus* spp.

M. berezovskii (Forest musk deer): China, Vietnam

M. chrysogaster (*chrysogaster* subspecies group) (Alpine musk deer): China, India

M. chrysogaster (*leucogaster* subspecies group) (Himalayan musk deer): Afghanistan, China, India, Nepal, Pakistan

M. fuscus (Black musk deer): Bhutan, China, India, Myanmar, Nepal

M. moschiferus (Siberian or taiga musk deer): China, Korea, Mongolia, former USSR

CITES:

M. berezovskii – II

M. chrysogaster – I (Afghanistan, Bhutan, India, Myanmar, Nepal, Pakistan populations)

M. chrysogaster – II (China population)

M. fuscus – II

M. moschiferus – II

1996 IUCN Red List Category:

M. berezovskii – LR(nt)

M. chrysogaster – LR(nt)

M. fuscus – LR(nt)

M. moschiferus – VU(A1a,c,d)

Musk deer (probably *Moschus chrysogaster*), India.



WWF/M.K. Ranjitsinh

Distribution and status in the wild

The musk deer is distributed sporadically throughout the forested, mountainous parts of Asia, ranging from just north of the Arctic circle, south to the northern edge of Mongolia and to Korea. It occurs further south (excluding the Gobi Desert) in China, northern Vietnam, Myanmar, and the Hindu Kush-Himalayan region of Afghanistan, Pakistan, and India (Flerov 1930, 1952; Dao 1977). Taxonomy of the genus *Moschus* is unresolved, particularly at the subspecies level, but there are now considered to be at least four and possibly as many as six species (Groves *et al.* 1987).

The forest musk deer, *M. berezovskii*, occurs in the following provinces of southern China: southern Shaanxi, southern Anhui, Hunan, Hubei, Guangdong, Guangxi, Yunnan, Guizhou, Sichuan, southern Gansu, southeast Qinghai, and southern Ningxia. Its distribution extends into northern Myanmar and northern Vietnam. Five subspecies are recognized by Wang *et al.* (1993).

The distribution of the alpine musk deer, *M. chrysogaster* [= *sifanicus*], encompasses Afghanistan, northern Pakistan, northern India, and central China (Grubb 1982). What is commonly referred to as the Himalayan musk deer is considered to be a subspecies of *M. chrysogaster* whose distribution extends north of the Himalayan divide into Tibet and southeast Qinghai. The overall distribution of the Himalayan musk deer south of the Himalayan divide has changed little during the 20th century, but widespread hunting and extensive habitat destruction have reduced the population to isolated fragments in many regions. This population was estimated at 30,000 animals, based on the extent of suitable habitat and the impact of hunting (Green 1986).

The black musk deer, *M. fuscus*, occurs in northwestern Yunnan (above 3,200m), where its distribution partly overlaps with that of *M. berezovskii* (Li, 1981), and the southeastern corner of Tibet, China (Li 1981; Ohtaishi and Gao 1990). It also occurs in Myanmar and Assam, India. An undescribed subspecies is found in the Everest region of Nepal, India (Sikkim), and Bhutan.

The Siberian musk deer, *M. moschiferus*, is found in the former USSR (Siberia and Sakhalin Island), northern Mongolia, China (northern Inner Mongolia, Heilongjiang, and Jilin), and Korea. It has disappeared from Sinkiang, Shanxi, Hebei, and Shaanxi (Bannikov 1980; Ohtaishi and Gao 1990).

Afghanistan: *M. chrysogaster* is present in a few parts of Nuristan (between 1,500m and 3,000m) where it was considered to be rare in 1977 (Habibi 1977).

- *Protected areas:* None.

Bhutan: *M. fuscus*, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs throughout much of

northern Bhutan, from about 2,600m to the tree line at 4,200m (Green 1985). It is considered to be rare (Yonzon 1992), but this may reflect the paucity of survey data.

- *Protected areas:* Black Mountains National Park, Jigme Dorji National Park (IUCN 1993).

China: The population of *Moschus* in China was estimated to be 600,000 (Sheng 1987), but the basis for this figure is unclear.

M. berezovskii is the most widely distributed and abundant species of musk deer in China. It occurs in southern Shaanxi, southern Anhui, Jianxi, Hunan, Hubei, Guangdong, Guangxi, Yunnan, Guizhou, Sichuan, southeastern Xizang, southern Gansu, southeast Qinghai, and southern Ningxia provinces (Wang *et al.* 1993). Five subspecies are recognized by Wang *et al.* (1993), of which four have contiguous distributions. *M. b. anhuiensis*, previously regarded as a subspecies of *M. moschiferus* (Ohtaishi and Gao 1990), is isolated from the other races and confined to the Dabie Mountains of western Anhui (Wang *et al.* 1993).

M. chrysogaster chrysogaster is found in southeastern Qinghai and southern Tibet. Its distribution abuts that of *M. c. sifanicus*, which inhabits the eastern edge of the Tibetan Plateau and Meridional Mountains. *M. c. sifanicus* is treated as an independent species *M. sifanicus* by Cai and Feng (1981). In the Pingwu, Markam, Anxian, Beichuan, Litang, Kangding, and Muli counties of western Sichuan the distributions of *M. c. sifanicus* and *M. b. berezovskii* overlap, but the former ranges above 3,000m and the latter from 1,000m to 2,500m (Ohtaishi and Gao 1990). Opinion is unanimous that musk deer populations in Qinghai have declined during the past decade, including in Baizha Forest, Nangqian County where densities of two to three animals per km² were recorded by Harris (1991). According to the Qinghai Provincial Government (1988), 66,000 musk deer were illegally harvested in 1985–1986. *M. fuscus*, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs in southeastern Xizang and northern Yunnan (Ohtaishi and Gao 1990).

M. moschiferus moschiferus is confined to the northern parts of Heilongjiang Province and Inner Mongolia. Its distribution is contiguous with that of *M. m. parvipes* which occurs in Heilongjiang and Jilin provinces (Ohtaishi and Gao 1990).

- *Protected areas:* Medog, Qomolangma, Tangjiahe, Wanglang and Wolong nature reserves (IUCN 1993). Changbal Mountain, Helan Mountain, Huaping, Jingpo Lake, Lishan Mountain, Liupen Mountain, Mount Fanjing, Poyang Lake, Shennonglia, Wuling Mountain, and Ziyunwanleng Mountain nature reserves (WCMC records).

India: *M. chrysogaster* occurs in parts of Kashmir, Himachal Pradesh, northern Uttar Pradesh, Sikkim, and

Arunachal Pradesh. Its altitudinal range extends from about 2,400m to above the tree line, which varies from about 3,200m in the Western Himalaya to 4,200m in the Eastern Himalaya. The species is likely to be most numerous in the eastern Himalaya where its habitat has been least disturbed. Further details of its status are given by Green (1985). Fewer than one animal per km². were recorded in Kashmir, and five to six per km². in Kedarnath Sanctuary, Uttar Pradesh (Green 1985, 1987).

M. fuscus, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs in Assam and Sikkim.

- *Protected areas*: Recorded in over 20 Himalayan national parks and sanctuaries (IUCN 1993).

Korea: *M. moschiferus parvipes* is considered to be in danger of becoming extinct (Won 1988). It occurs in the wooded, mountainous parts of the Korean peninsula, but information on its present distribution is lacking.

- *Protected areas*: No information.

Mongolia: *M. moschiferus* is found in the taiga of Hentei and Hovsgol, parts of Hangai, and possibly in the Han Hohii massif in the northwest. It is uncommon due to hunting for musk (Mallon 1985).

- *Protected areas*: Likely to occur in Khorgo Reserve (Hangai); Ar-Toul and Gorkhi-Terelj National Parks, and Bogdkhan Uul and Khan Khentii Uul reserves (Hentei); and Khovsgul Nuuer National Park (Hovsgol).

Myanmar: *M. fuscus*, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs only in Kachin State of northern Myanmar. It is generally found above 2,400m in the hills around Putao.

- *Protected areas*: None.

Nepal: *M. chrysogaster* is widely but discontinuously distributed throughout the Himalaya from about 3,000m to 4,400m (Green 1985). The population is thought to be increasing within protected areas but declining outside them. Sagarmatha National Park has an estimated 600–800 animals, with up to 45 per km². Elsewhere, there are an estimated 500 animals in Langtang National Park, 20 in Rara National Park and, >1,000 in Shey-Phoksundo National Park (B. Kattel, pers. comm. 1990).

M. fuscus, considered by some authorities to be a subspecies of *M. chrysogaster*, occurs in the Everest region.

- *Protected areas*: As above. Also present in Dhorpatan Hunting Reserve, Khaptad National Park, and Makalu-Barun National Park/Conservation Area (IUCN 1993).

Pakistan: *M. chrysogaster* is widespread from 3,000m to 4,000m in the Northern Areas, but has become rare in Chitral and the Indus Kohistan, North-West Frontier Province. It has never been as plentiful in the northwestern

Himalaya as further east where it inhabits lower altitudes due to the higher rainfall (Roberts 1977).

- *Protected areas*: Astore, Baltistan, Kargah, Manshi, Nar/Ghoro Nallah, Satpara Wildlife Sanctuaries (IUCN 1993).

Former USSR: *M. m. moschiferus* is widely distributed throughout eastern Siberia, from the Altai Mountains in the west to the Kolymskiy Mountains in the east; *M. m. parvipes* occurs in the Ussurisk region of eastern Russia (Whitehead 1994); and *M. m. sachalinensis* is restricted to four populations in the southern half of Sakhalin Island (V.E. Priszajhnyuk, pers. comm. 1994). *M. moschiferus* does not occur above 1,600m in the former USSR. Bannikov *et al.* (1980) estimated the total population in the former USSR to be approximately 100,000, based on a mean density of 0.6 animals per km³ (densities rise to 20 animals per km² in optimal habitats). Following the disintegration of the former USSR, populations are declining and are currently estimated to total 56,000–60,000, with 29,000–30,000 in the Altai and Sajany, 18,000–19,000 around Lake Baikal, 5,000–6,000 in Siberia, 4,000–5,000 in the Far East, and 300–350 on Sakhalin Island (V.I. Prikhod'ko, pers. comm. 1994). In Khabarovsk Krai (Far East), there were an estimated 18,000 musk deer in 1994, according to Khabarovsk Game Department.

M. moschiferus was thought to have declined by 50% in the former USSR during the mid-1980s due to the great international demand for musk. In the Altai, a fivefold decline has been reported in the population, which was estimated at 40,000–45,000 in 1986 (Prikhod'ko 1987). Local populations in Siberia (Krasnojarsk Krai) and the Far East (Khabarovsk Krai) are severely threatened by illegal harvesting (G. Schürholz, pers. comm. 1995).

- *Protected areas*: Occurs in a total of one national park, 21 zapovedniks, and five other protected areas (V.I. Prikhod'ko, pers. comm. 1994). In Russia, it is present in Komsomolskiy, Sikhote-Alinskiy, Ussyriyskiy, and Zeyskiy zapovedniks (Golovanov 1985; G. Gonzalez 1994) and Altaiskiy, Baikal'skiy, Barguzinskiy, and Bol'shekhkhtsizkiy zapovedniks (WCMC records).

Vietnam: *M. berezovskii* occurs in Lang Son and Cao Bang provinces of northeastern Vietnam. In 1990 there were an estimated 200–300 in Cao Bang Province, but the population is decreasing (H.H. Dang, T. van Dao and M.K. Hoang, pers. comm. 1990).

- *Protected areas*: Trung Khanh Nature Reserve (H.H. Dang, T. van Dao and M.K. Hoang, pers. comm. 1990).

Past distribution and status

The distribution of *M. moschiferus* in China has contracted. *M. m. moschiferus* disappeared from the

northeastern corner of Sinkiang at the end of the 19th century, the last recorded locality being Qitai County (Gao 1985). Until the thirteenth century, *M. m. parvipe* was found in northern Shaanxi Province. More recently it has disappeared from Shanxi and Heibei provinces.

The overall range of *M. chrysogaster* south of the Himalayan divide has changed little during this century, but populations have been reduced to isolated pockets in many regions (Green 1986).

Status in captivity

Table 21. Status of <i>Moschus</i> spp. in captivity.				
Country/State	Institution	Population structure	Total	Year Ref.
China/Shanghai	Chongmin	6.9.0	15	H. Sheng, pers. comm. 1990, 1984 (Green 1989)
China/Sichuan	various farms	?	1000	"
Germany	Zoologischer Garten Leipzig	3.2.0	5	1993 (Olney <i>et al.</i> 1994)
India	Dachigam Nat'l. Park, J&K	1.0	1	1980 (Green 1981)
	Kufri, H.P.	4.1.0	5	1980 (Green 1981)
	Kedarnath Sanctuary, H.P.	7.5.0	12	1990 (Bhadauria 1990)
	Meroli, U.P.	3.4.0	7	1980 (Green 1981)
Italy	Parco Faunistico "La Torbiera"	1.1.0	2	1993 (Olney <i>et al.</i> 1994)
Former USSR	Chernogolovka Research Station	12.10.0	22	V.I. Prikhod'ko, pers. comm. 1994
	Novosibirsk Zoo	0.2	2	1993 (Olney <i>et al.</i> 1994)
	Telezkaja Biol. Stn.	?	9	V.I. Prikhod'ko, pers. comm. 1994
	Tomsk Zoo	1.1	1	1993 (Olney <i>et al.</i> 1994)
Ukraine	Khar'kov Zoo	1.0	1	1993 (Olney <i>et al.</i> 1994)

Maintained in captivity in farms for harvesting musk, and in zoos mainly in India, China, and the former USSR. The Chinese experience in farming musk deer is summarized by Zhang *et al.* (1979).

Ecology and reproduction

Habitat and food preference: Musk deer inhabit montane forests and subalpine scrub throughout their distribution. Dense undergrowth, typically of rhododendron, bamboo, and other shrubs, is requisite, with a marked preference for steep mountain slopes (Bannikov 1980; Green 1987a).

Musk deer are concentrate feeders, selecting nutritious food plants, or parts thereof, that are high in protein and energy (sugars) and low in fiber. Forbs and woody plants constitute the bulk of diet in summer and winter, respectively (Green 1987b). In winter, when food may be in short supply, musk deer can survive on poorer quality diets consisting largely of lichen (Ustinov 1969).

Average group size and dispersion pattern: Essentially solitary, except during the rut when male-female pairs may be observed (Green 1987a; Harris and Cai, in press).

Movements: Sedentary, with a home range of 15–32ha in the Himalaya and Tibetan Plateau. Movement to feed in more exposed parts of the range, such as alpine meadows, usually occurs at night (Green 1987a; Harris and Cai, in press).

Musk deer do not usually move to lower altitudes with the onset of winter, since they are well insulated from the cold and well-adapted to move through deep, soft snow (Green 1987a). However, in some parts of Russia, food supplies and shelter may become obliterated by snow in winter, causing musk deer to migrate up to 35km (Bannikov *et al.* 1980).

Reproduction: Breeding is seasonal, with young born in May–June, following a gestation period of 178–198 days. There appears to be a trend of increasing length of gestation with increasing size of species: *M. berezovskii*, the smallest species, has the shortest gestation; *M. chrysogaster*, the largest species, has the longest; and *M. moschiferus* occupies an intermediate position with respect to both its size and gestation period (Green 1989).

Litter size varies between one and three (Green 1989). The incidence of twins is higher than single births in *M. berezovskii* and *M. moschiferus*; conversely, single births are predominant in *M. chrysogaster*. Young grow rapidly, becoming independent of their mothers by about six weeks. They attain most of their adult body weight by six months and sexual maturity by 18 months of age. Females are capable of breeding in their first year (Green 1987a, 1989).

Uses

Subsistence: Musk deer are hunted principally for their musk, a secretion of the male preputial gland or *pod* which is used in traditional Chinese, Hindu (*ayurvedic*), and

Moslem (*unani*) medicines. It is allegedly a cardiac, circulatory, respiratory, and sexual stimulant, as well as a sedative for nervous disorders (Pereira 1857; Mukerji 1953; Anon 1979). The meat and other products, such as canine tusks (for jewelry) and hair (for insulation in pillows), may also be used in remote areas where risks of apprehension are minimal (M.J.B. Green, pers. comm. 1995).

Commercial: Musk is used commercially in oriental medicines, and due to its highly valued fixative and scent properties, in perfumery. It was used in China and India as far back as 3,500 BC, and by the 7th century AD was traded with the Arabs (Genders 1972). The quantity of musk currently traded commercially is unknown.

Relatively little musk is currently used in perfumery due to its increasing scarcity and high cost, and commensurate replacement by much cheaper synthetic alternatives. Most musk is used in traditional medicines, notably in China, where musk deer are farmed commercially for the production of musk, and also in Japan, the world's leading importer of musk. In China, musk deer have proved difficult to farm intensively, and usually captive stocks are replenished with animals from the wild. The economic viability of harvesting musk from either captive or free-ranging musk deer has yet to be properly assessed (Green 1986, 1989).

Musk is among the most valuable animal products in the world, worth three to four times its weight in gold. In the 1970s, its international market value was up to US\$45,000 per kg. At that time, Japan was the largest importer of musk, accounting for some 85% (275kg) of the international trade (Green 1986). In the early 1980s, total annual musk production in China was 2,000–2,500kg, of which 500kg originated from *M. berezovskii* (Wang *et al.* 1993). In the Russian Altai, 50kg was officially traded in 1990–91, which was thought to represent about 10,000–20,000 musk deer, *M. moschiferus* (Prikhod'ko 1987).

Causes of decline and present threats

Widespread illicit hunting is largely responsible for the dramatic decline in musk deer populations this century. Given that a single musk pod, weighing 25g on average, will provide a pastoralist family with 6–12 month's cash income (Jackson 1979; Harris 1991), hunting is very intense and populations within a given valley may be wiped out within a few years. Hunting, traditionally with snares but increasingly with guns, is largely indiscriminate of the age and sex of animals. As a result, four or five musk deer may be killed for every pod-bearing male secured (Jackson 1979; Green 1986).

Habitat destruction, characteristic of many Himalayan and other mountainous regions, is also a serious threat due to increasing human and livestock populations. This

applies particularly to the shrub layer of vegetation which provides musk deer with food and camouflage from predators, including humans. Expanding pastoralism may also affect musk deer indirectly through predation and harassment by domestic dogs, used to protect livestock (Green 1986; Harris 1991).

Field studies

Early Russian surveys and ecological studies of *M. moschiferus* are reviewed by Bannikov *et al.* (1980), but there has been little extensive field research since then. Intensive ecological studies of *M. chrysogaster* have been conducted in Kedarnath Sanctuary, northern India by Green (1987a, 1987b, 1987c, 1987d), and more recently by S. Sathyakumar (pers. comm. 1992). Studies have also been undertaken by B.J. Kattel (pers. comm., 1990) in Sagarmatha National Park, Nepal.

Chinese research has focused on captive breeding for musk production. Ecological studies have been carried out by Zheng and Pi (1979) and Harris and Cai (in press) in Qinghai Province, and by Wang and Sheng (1988) and Sheng *et al.* (1990) in Sichuan Province.

Conservation action to date

In general, musk deer are protected under national legislation in many range states. However, inadequate human resources have limited the effectiveness of protection efforts, even within protected areas harboring musk deer. The population is arguably best protected in Bhutan, where poachers may legally be shot on sight.

Afghanistan: No legal protection or other conservation action.

Bhutan: Totally protected by Royal Decree.

China: Protected as a Category II *key* species under the federal *Wildlife Protection Law, 1988*. Category II species may be taken only under permit granted by the provincial authority. Qinghai Provincial Government has promulgated a special *emergency notice*, under its *Wildlife Resources Protection and Management Regulations, 1988*, to draw attention to the plight of the musk deer and to strengthen its protection. However, there is no evidence to suggest that legal protection has been effective (Harris 1991). Efforts to establish an effective network of nature reserves to conserve the Giant Panda have indirectly benefited *M. berezovskii* which occurs in similar habitat.

India: Totally protected under the federal *Wildlife (Protection) Act, 1972*.

Korea: Protected since 1968 when it was designated as Natural Monument No. 216. A Musk Deer Preservation Council was established in 1978 under the auspices of the Korean Wildlife Preservation Association. No recent information.

Mongolia: Totally protected as an endangered species under new legislation introduced on 5 June 1995.

Myanmar: Totally protected under the *Nature and Wildlife Law, 1994*.

Nepal: Totally protected under the *National Parks and Wildlife Conservation Act, 1973*.

Pakistan: No legal protection or other conservation action at national level.

Former USSR: In the Russian Federation, musk deer are hunted under license but regulations vary between krajs. For example, in Khabarovsk Krai, the legal harvest quota in 1994 was 2,000, whereas in Krasnojarski Krai, hunting has been prohibited since 1994 (G. Schürholz, pers. comm.). In Sikhote-Alinskiy Zapovednik, the legal annual harvest is 70 musk deer (Gonzalez 1994). It is planned to establish a zapovednik by 2000 for the protection of *M. m. sachalinensis* on Sakhalin Island (V.E. Prsjazhnyuk, pers. comm. 1994).

Vietnam: Protected under national legislation since 1963.

Recommended conservation action

Given that *Moschus* is declining throughout its distribution because of hunting and habitat destruction, it is only a matter of time before all species will be threatened with extinction. Thus, the following recommendations apply to all species of *Moschus*.

1. Review control of the international trade in musk through appropriate listing of musk deer populations in appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
2. Provide adequate legal protection in all range countries, including measures to control internal and external trade in musk. For example, introduce appropriate legislation in Afghanistan and Pakistan. In India, close the loophole which protects species but does not prevent musk from being traded within the country.
3. Establish protected areas in Afghanistan and Myanmar.
4. Enforce strict protection within protected areas to curb poaching and regulate human activities such as pastoralism (Green 1985).

5. Examine potential for sustainable production of musk through farming or hunting. This should be managed by local communities to provide an incentive to conserve *Moschus* and its habitat (Green 1989; Harris 1991).

Reporters: Richard B. Harris, Shangjian Yu, Sheng Helin, Zhang Endi (China); Michael J.B. Green (India); Bijaya Kattel (Nepal); Dang Huy Huyn, Tran Van Duc, Hoang Min Khien, and Radoslaw Ratajszczak (Vietnam); Vladimir I. Prikhod'ko, Vitaliy E. Prsjazhnyuk (Russia).

Black or hairy-fronted muntjac *Muntiacus crinifrons*

China

CITES: I

1996 IUCN Red List Category: VU(C1)

Distribution and status in the wild

Restricted to altitudes of 200–1,000m on the border of Jiangsu, Anhui, and Zhejiang provinces. In the 1980s, the population was estimated at less than 5,000 animals and declining (Ohtaishi and Gao 1990). The species probably occurs at low density. (Sheng Helin and Zhang Endi, pers. comm.). Recently discovered to occur in northern Myanmar, north of the river Nam Tamai (Rabinowitz, in press).

- *Protected areas:* Jiugong Nature Reserve.

Past distribution and status

Range formerly extended from the coastal region of Ningbo

Black or hairy-fronted muntjac (*Muntiacus crinifrons*).



J. Dolan

at the mouth of the Yangtze River, westward to Guangdong and Yunnan provinces (Ohtaishi and Gao 1990).

Status in captivity

In 1989, five animals were held in captivity in separate locations in China (DSG 1989).

Ecology and reproduction

Habitat and food preference: Occurs in mixed forest and scrub (Sheng Helin and Zhang Endi, pers. comm.).

Average group size and dispersion pattern: Solitary.

Movements: Seasonal altitudinal movement (Sheng Helin and Zhang Endi, pers. comm.).

Reproduction: Young are born throughout the year (Sheng Helin and Zhang Endi, pers. comm.) following a gestation period of 210 days. Sexual maturity is reached at approximately one year (Sheng and Ohtaishi 1993).

Uses

Subsistence: Hunted for venison and skin (Sheng Helin and Zhang Endi, pers. comm.).

Commercial: 500 animals are killed annually for skins, which are sold on local markets (Ohtaishi and Gao 1990).

Causes of decline and present threats

No information.

Field studies

No information.

Conservation action to date

No information.

Recommended conservation action

1. Initiate research to determine status and threats throughout the species' range. Activities should include field reconnaissance, population censuses, demographic

surveys, ecological studies, and investigations into human use of the animals.

2. If necessary, establish captive breeding program (Sheng Helin and Zhang Endi, pers. comm.).

Reporters: Sheng Helin, Zhang Endi.

Fea's muntjac *Muntiacus feae*

M. f. feae: China, Myanmar, Thailand

M. f. rooseveltorum: China, Laos

CITES: Not listed

1996 IUCN Red List Category: Both subspecies DD

Distribution and status in the wild

M. f. feae has been reported in southwestern Yunnan and eastern Xizang provinces, China, and in peninsular Thailand and Myanmar; *M. f. rooseveltorum* occurs in northern Vietnam, Laos, and probably Yunnan Province, China (Ohtaishi and Gao 1990).

- *Protected areas:* *M. f. feae* occurs in Khlong Nakha, Khlong Saeng, and Thung Yai-Kha Khaeng Wildlife Sanctuaries and probably Kaong Kiachar National Park, Thailand (Wirth and Oliver, undated).

Fea's muntjac (*Muntiacus feae*).



Past distribution and status

M. f. feae probably occurred along the length of the Tenasserim Mountains which border Thailand and Burma (Wirth and Oliver, undated).

Status in captivity

Country/State	Institution	Population		Year Ref.
		structure	Total	
Thailand	Dusit Zoo	3.6.0	9	1991*
	Chiengmai	?	4	1992*
	Khao Kheow	3.2.0	5	1993**
* Wirth and Oliver (Undated)		** ISIS (1993)		

A preliminary studbook was prepared of the captive Thai population in 1987, but was not maintained by the Thailand Zoo Organization (C. Wemmer, pers. comm.).

Ecology and reproduction

Habitat and food preference: No information.

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: Single fawn. Sexual maturity is thought to be reached after the first year (Sheng and Ohtaishi 1993).

Uses

Subsistence: No information.

Commercial: No information.

Causes of decline and present threats

No information.

Field studies

No information.

Conservation action to date

No information.

Recommended conservation action

1. Initiate research to determine status and threats throughout the species' range. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.
2. If necessary establish a cooperative captive breeding program in collaboration with the Thai Royal Forest Department.

Gongshan muntjac *Muntiacus gongshanensis*

China, India?, Myanmar?

CITES: Not listed

1996 IUCN Red List Category: DD

Distribution and status in the wild

Reported from southwestern Yunnan Province, China and southeastern Tibet. Possibly ranges into eastern Arunachal Pradesh, India. The Yunnan population may be close to extinction (Wirth and Groves 1988). Rabinowitz (pers. comm.) has identified the species in northern Myanmar (north of Putao) on the basis of genetic analysis of salvaged specimens obtained from hunters.

- *Protected areas:* No information.

Past distribution and status

No information

Status in captivity

Country/State	Institution	Population		Year Ref.
		structure	Total	
China	Kunming Inst. Zoology	0.1.0	1	1988 Shi Liming

Shanghai Zoo held six animals in 1982 which have since died (R. Wirth, pers. comm.).

Ecology and reproduction

Habitat and food preference: No information.

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: No information.

Uses

Subsistence: No information.

Commercial: No information.

Causes of decline and present threats

Heavy hunting pressure from hill tribes has been reported from Yunnan Province (R. Wirth, pers. comm. 1990).

Field studies

No information.

Conservation action to date

None.

Recommended conservation action

1. Initiate research to determine status and threats throughout the species' range. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.
2. Based on the research results, determine the need for an ex-situ captive breeding program based at the Kunming Institute of Zoology.
3. In areas where subsistence hunting proves to be a serious threat, develop alternative subsistence schemes or more sustainable harvesting methods. Develop conservation education programs and increase law enforcement if necessary.

Reporters: Shi Liming, R. Wirth.

Balabac mouse deer *Tragulus napu nigricans*

Philippines – Balabac Island, Palawan Island?

CITES: Not listed

1996 IUCN Red List Category:

LR(lc); DD (DSG recommended)

Distribution and status in the wild

Endemic to Balabac Island, Philippines, where it is probably declining. Reported to have been introduced to south Palawan Island (Oliver 1993).

- *Protected areas:* None.

Past distribution and status

No information.

Status in captivity

Successfully bred in captivity on Calauit Island, Philippines (Oliver 1993).

Ecology and reproduction

Habitat and food preference: No information.

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: No information.

Uses

Subsistence: Intensively hunted by local people (Oliver 1993).

Commercial: No information.

Causes of decline and present threats

Habitat loss and hunting (Oliver 1993).

Field studies

None.

Conservation action to date

None.

Recommended conservation action

Oliver (1993) has proposed the following initial recommendations:

1. Initiate research to determine status and threats throughout the species' range. Activities should include field reconnaissance, population censuses, demographic surveys, ecological studies, and investigations into human use of the animals.
2. Develop conservation awareness program and education poster to focus interest on Balabac Island.
3. In areas where subsistence hunting proves to be a serious threat, seek alternative subsistence schemes or more sustainable harvesting methods. Increase law enforcement if necessary.
4. Establish protected areas with buffer zones.

Truong Son muntjac (*nomen nudum*)

Vietnam

CITES: Not listed

1996 IUCN Red List Category:

NE (Not Evaluated); DD (DSG recommended)

Distribution and status in the wild

This species was discovered to western science in April 1997 by a team of scientists from Vietnam's Ministry of Agriculture and Rural Development, Danang University and WWF. It was found in the Truong Son mountain range in the west Vietnam province of Quang Nam, close to the Laos border. Its range probably extends northwards and possibly eastwards into Bach Ma National Park, but this remains to be confirmed. Scientists found 18 skulls from local hunters, who call it *sam soi cacooong* in their Ca Tu indigenous language, which means "the deer that lives in the deep, thick forest". The Truong Son muntjac is the third new large mammal species discovered in Vietnam in the last years, after the soala (*Pseudoryx nghetinhensis*) and giant muntjac (*Megamuntiacus vuquangensis*) were discovered in 1992 and 1994 respectively.

- *Protected areas:* The Truong Son area contains several reserves including Vu Quang.

Past distribution and status

No information.

Status in captivity

None.

Ecology and reproduction

Habitat and food preference: Inhabits forests with dense undergrowth at 400–1,000m.

Average group size and dispersion pattern: No information.

Movements: No information.

Reproduction: No information.

Uses

Subsistence: Hunted for meat by local people.

Commercial: None.

Causes of decline and present threats

No information.

Field studies

No information.

Conservation action to date

WWF is working to conserve the Truong Son area.

Recommended conservation action

Conservation of the Truong Son area in close collaboration with development activities working to eradicate poverty in the area. Expansion of the reserve should be considered.

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Decision Tree for Prescribing Management Action

Chris Wemmer, Dale Miquelle and Eric Dinerstein

The decision tree was drafted to facilitate consistent management recommendations as the plan was being developed. The intention was not to present a cut-and-dry formula, but to encourage a systematic process in evaluating the threats and their management implications. Our information on almost every taxon is based on a limited number of sources. Therefore, prescriptions for management action should not be considered as definitive solutions. Because of geographical differences between areas, any number of alternative actions may be possible, and in most cases several actions would be necessary to significantly reduce threats for a sustained period. The implementation of any management action would also require careful evaluation of methods, and should be thoughtfully integrated with other actions.

1. Status of species

- a. Meets criteria for IUCN Red List categories (Critically Endangered – CR, Endangered – EN, or Vulnerable – VU) **go to 2**
- b. Does not qualify for IUCN categories CR, EN, VU species/population not threatened

2. Protection efforts

- a. Adequate protection (protected areas, policy, and enforcement exist and are effective) **go to 6**
- b. Inadequate protection (protected areas, policy, or enforcement do not exist or are inadequate) **go to 3**

3. Threat identification

- a. Threats well identified **go to 4**
- b. Threats ill-defined, information needed **go to 5**

4. Identification of threats and prescribed management responses

Threats	Prescribed management action
Existing wild population not viable (distribution fragmented, populations declining or at very low numbers)	If population status is critical: 1) protect remaining habitat or create protected areas 2) consider establishment of captive populations 3) consider establishment of additional wild populations when and where appropriate
Lack of trained manpower	Develop appropriate training opportunities for field staff and administrators
Lack of conservation awareness or ethic	Facilitate development of conservation NGOs; develop conservation education programs for all local communities and appropriate segments of the population
Within Least Developed countries, lack of sufficient indigenous funding to implement conservation action plans	Seek financial support from conservation NGOs, and foundations, bi-lateral and multi-lateral conservation agencies which promote conservation
Lack of communication/coordination among responsible agencies	Establish interagency task force for management of threatened species
Policy pertaining to protected areas, trade, and hunting: a) Does not exist b) Exists, but is inadequate c) Exists, but is unenforced	Draft legislation Revise legislation Bolster law enforcement
Over-exploitation	Evaluate decision-making process in establishing hunting quotas
Poaching: a) Subsistence b) Other products (e.g. musk)	Develop conservation education program; increase law enforcement if necessary; seek alternative subsistence scheme Enhance law enforcement; examine potential and capacity for deer farming

Threats	Prescribed management action
Habitat loss due to: a) Human encroachment within protected areas b) Logging (clearcut) c) Conversion to agriculture d) Environmental catastrophes	Enforce strict protection of core area, incorporate buffer zones, provide alternative sites for rural development Create protected core area, integrate logging techniques with other ungulate habitat requirements, integrate management of watersheds with deer management Create protected area, incorporate buffer zones Provide multiple large areas
Habitat change: (vegetation/landscape/dynamics) a) Logging (selective) b) Fire c) Livestock d) Loss of early successional habitat	Create protected core area, integrate logging techniques with other ungulate habitat requirements, integrate management of watersheds with deer management Control burning regime Create protected core area and buffer zone; exclude livestock with physical barriers and law enforcement; improve livestock management through farmer education and demonstration projects Institute burning or logging regime
Disease	Reduced herd size; vaccination; establish and maintain isolated subpopulations
Hybridization	Evaluate costs and benefits of identifying and removing hybrids: a) abandon conservation efforts for the population b) develop and implement recovery plan for pure stock
Inbreeding	Introduce unrelated stock to the population; monitor reproductive success of new stock.
Predation	Evaluate status of predator; consider reduction of predators by direct means or through habitat modification; enhance status of alternative prey species
Competition: a) Feral stock b) Livestock c) Native fauna	Remove feral stock Exclude livestock with physical barriers and law enforcement; reduce numbers of livestock; improve livestock management through farmer education demonstration projects Modify habitat to promote conservation of threatened species; monitor populations of native herbivores; reduce numbers of competing species
Intrinsic life history parameters	Incorporate information into existing management plan, or create a protected area management plan
Human disturbance	Improve law enforcement or regulate human activities to reduce disturbance

5. Information and data acquisition

- a. Field reconnaissance
- b. Population census
- c. Demographic survey
- d. Ecological studies
 - i) food habits
 - ii) forage availability and quality
 - iii) habitat requirements (cover, water, licks, etc.)
 - iv) vegetation/landscape dynamics
 - v) spacing, social organization
 - vi) interaction with other herbivores
 - vii) predator-prey interactions
 - viii) disease
- e. Genetic analyses
- f. Sociological studies
 - i) human use
 - ii) cultural attitude
 - iii) ecotourism potential

6. Review literature to determine extent and completeness of biological knowledge of the species, and develop a research plan to fill in the gaps

Appendix 2

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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

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 and 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.

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:

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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 ecological 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).

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

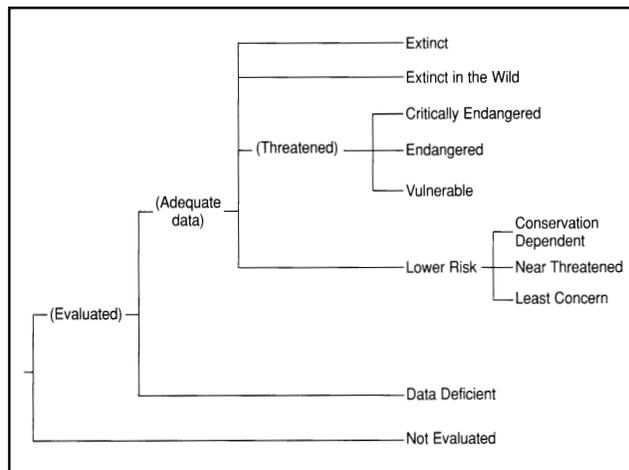
The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be acceptable throughout. Inference and projection may be based on extrapolation of 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

Figure 1: Structure of the Categories



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 five 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 the area will be 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.

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 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).

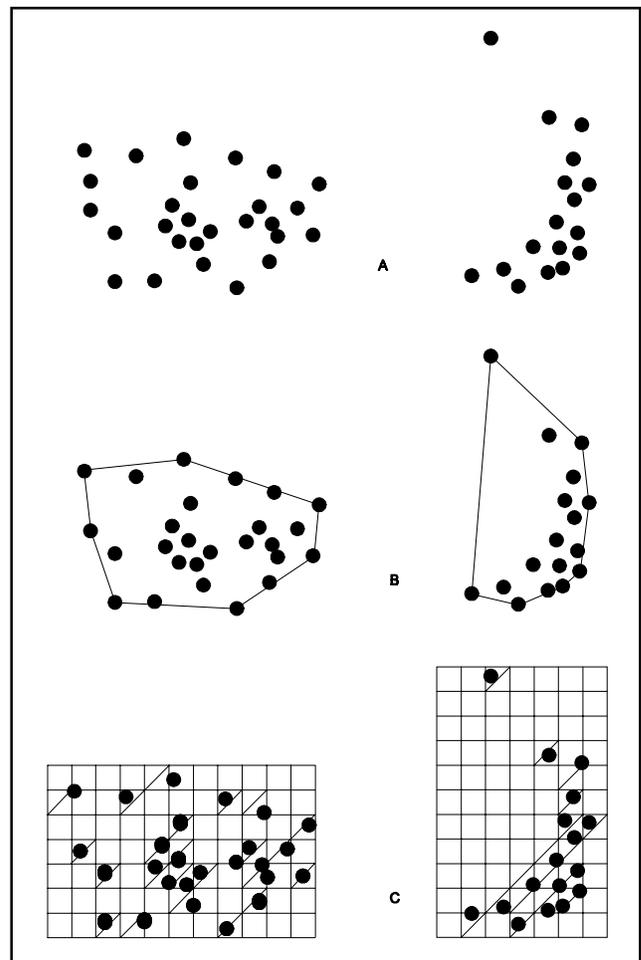


Figure 2: Two examples of the distinction between extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one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

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 km², and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 2).

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.

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 104–105.

ENDANGERED (EN)

A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on page 105.

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 105 and 106.

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. 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 has not yet been assessed against the criteria.

V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)

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

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

- 1) An observed, estimated, inferred or suspected 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 10 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 100km² or area of occupancy estimated to be less than 10km², 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 three 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 three generations, whichever is the longer.

ENDANGERED (EN)

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

- A) Population reduction in the form of either of the following:
- 1) An observed, estimated, inferred or suspected 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 10 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 5000km² or area of occupancy estimated to be less than 500km², 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 five years or two 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 five 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 20,000km² or area of occupancy estimated to be less than 2000km², 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 three 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 100km²) or in the number of locations (typically less than five). 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.

Note: copies of the IUCN Red List Categories booklet, are available on request from IUCN (address on back cover of this Action Plan)

¹ Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages.