FROM THE EDITORS

In this issue of the Asian Wild Cattle Specialist Group Newsletter, we make a request to members of the Group to send whatever information they might have on the Asian Wild Cattle that might be useful in conservation. The Group's Executive Committee is concerned that the survival of species of wild cattle is of great importance in the long-term. In the short-term, it is hoped to publish the Asian Wild Cattle Specialist Group Newsletter that would make an assessment on the status of the wild cattle species. It is known that Asian Wild Cattle are threatened with continued loss of survival in the wild because of continued hunting and trade pressures. On the domestic level, there is a need to prevent the extinction of these species.

Of the 12 species of wild cattle, eight are restricted to southern and southeast Asia. All these species are considered to be threatened. The species in question are:

1. Gaur (Bos gaurus) found in the Indian subcontinent to Indochina, mainland only. (Vulnerable)
2. Banteng (Bos javanicus): From Burma to Indochina, south to Malaysia, Java and Borneo. (Vulnerable)
4. Wild Yak (Bos grunniens): Tibet (China) and other high altitude areas of Central Asia. (Endangered)
5. Wild Water Buffalo (Bubalus bubalis): A few locations in India, Nepal, Thailand and possibly elsewhere. (Endangered)
6. Tamaraw (Bubalus mindorensis): The island of Mindoro, the Philippines. (Endangered)
7. Lowland Anoa (Bubalus depressicornis): Indonesia (Endangered)
8. Mountain Anoa (Bubalus arnee): Become extinct in the Philippines. (Endangered)

2. The relative conservation priority awarded to each species of the Asian Wild Cattle needs to be increased. The most urgent and critical conservation problems of the Asian Wild Cattle need to be identified.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

SPECIES SURVIVAL COMMISSION

WWF World Wide Fund For Nature

Produced with the assistance of World Wide Fund for Nature
FROM THE EDITORS

In this issue of the Asian Wild Cattle Specialist Group Newsletter, we make a request to all members of the Group to send whatever information they may have on the Asian Wild Cattle that might be useful in compiling an Action Plan. The whole point of this exercise is to help conserve the species of wild cattle throughout their range in Asia. While this is the long-term objective of the Group, in the short-term it is hoped to publish an Action Plan that would make an assessment of the status of the wild cattle throughout Asia and propose measures that would ensure not only their continued survival in their present habitats, but also restore, where feasible, populations of wild cattle to productive levels.

Of the 12 species of wild cattle, eight are restricted to southern and south-east Asia. All these species are considered to be threatened to a greater or lesser extent. The species in question are:

1. Gaur (*Bos gaurus*): found in the Indian subcontinent to Indochina, mainland only. (Vulnerable)
2. Banteng (*Bos javanicus*): from Burma to Indochina, south to Malaysia, Java and Borneo (Vulnerable)
3. Kouprey (*Bos sauvelii*): Indochina (Endangered)
4. Wild Yak (*Bos grunniens*): Tibet (China) and other high altitude areas of Central Asia (Endangered)
5. Wild Water Buffalo (*Bubalus bubalis*): A few locations in India, Nepal, Thailand and possibly elsewhere (Endangered)
6. Tamaraw (*Bubalus mindorensis*): The island of Mindoro in the Philippines (Endangered)
7. Lowland Anoa (*Bubalus depressicornis*): The island of Sulawesi, Indonesia (Endangered)

With the exception of the last three of these species, all the Asian Wild Cattle have been domesticated (or probably so in the case of the Kouprey), and sometimes hybridized. The presence of domesticated stock is a major threat to wild populations, both in terms of inter-breeding and disease. Both the Yak and the Water Buffalo are abundant as domesticated populations but are very rare in the wild.

An Action Plan for these species is important for the following reasons:

1. There is a need to gather all the recent information on the status and conservation of these species.
2. The relative conservation priority accorded to each species of the Asian Wild Cattle needs to be assessed.
3. The most urgent and critical conservation problems of the Asian Wild Cattle need to be identified.
4. There is a need to draw attention to the problems of the Wild Cattle among conservationists and wildlife managers in Asia.
5. It is important to start conservation programmes soon if all eight species of Asian Wild Cattle are to be preserved in the wild for future generations of people.
6. The Asian Wild Cattle form a valuable genetic reservoir for future work on domestication and breeding of cattle.

A start has been made with this issue of the Newsletter in which we publish a preliminary draft on the Status, Distribution and Conservation of Tamaraw (*Bubalus mindorensis*) in the Philippines. We would welcome comments and criticisms from our members so that this draft could be greatly im-
We also earnestly appeal to the members to provide us with information on other wild cattle in your area to enable us to prepare draft country chapters. We would greatly appreciate if distribution maps of the Asian Wild Cattle species could be sent to us. We look forward to hearing from you.

Yo Quy
Chairman: Asian Wild Cattle Specialist Group

Charles Santiapillai
Executive Secretary
The Status, Distribution and Conservation of Tamaraw (Bubalus mindorensis) in the Philippines

by

Charles Santiapillai
WWF—Regional Programme (Asia)
PO Box 133, Bogor, Java Barat, Indonesia

1.0 The Philippines: an overview

In introducing the Philippines, three features stand out as significant: these are its location, its archipelagic nature and the density and distribution of its human population. The Philippines archipelago (Fig. 1) with about 7,100 islands lies in the South China Sea between latitudes 4°40'N to 21°50'N and longitudes 116°50'E to 136°35'E. The total land area of the archipelago amounts to 300,000 km². 11 islands account for more than 95% of the land area (Petocz 1988). The topography is dominated largely by mountainous terrain with narrow and interrupted coastal plains. The Sierra Madre on Luzon, extends along the Pacific coast from Cagayan province in the north to Quezon province in the south and is the longest mountain range in the archipelago. Only about 10 out of the 50 volcanoes are active. Most of the islands are either of volcanic origin or coral islands.

Much of the vegetation has been destroyed as a result of the demands of the human population of over 60 million and growing at an annual rate of 2.8%. At this rate, the population could double within the next 35 years. Forest cover has declined drastically during the recent decades. Only 21% of the land area is under some form of forest cover and logging and shifting cultivation (kaingin) account for the annual loss of about 170,000 ha of forest (Petocz 1988). As a result forest area is being rapidly replaced by the tough, coarse Cogon grass (Imperata cylindrica). Rice is the principal staple crop which is grown almost all over the archipelago. The climate is tropical with two marked seasons: dry and wet. The dry season extends from December to May. About 220 species of mammals and 500 species of birds are known from the archipelago.

2.0 Current Status of the Wild Cattle

The Tamaraw (Bubalus mindorensis) is the only wild cattle found in the Philippines and it is endemic to the island of Mindoro Occidental (Fig. 2). In appearance, it resembles a miniature water buffalo of the swamp type that is found in Southeast Asia (Anon 1983) but it has more hair on its body than the water buffalo. The adult reaches a height of 1 m at the shoulder and is dark brown to greyish black in colour. The horns are short, only about 355–510 mm long (Walker 1975).

The Tamaraw inhabits dense grasslands and reed beds in moist areas as well as the bamboo forests in mountainous areas in the Mindoro island. Its numbers are small and confined to a few localities and the species is considered to be seriously endangered (IUCN 1988). However, in the distant past when the island had a substantial forest cover and scattered grasslands, the Tamaraw enjoyed a wider distribution and greater numbers than today. It is estimated that the numbers had fallen from about 10,000 at the turn of the century to about 150–200 animals by 1975 (Kuehn 1975, 1976, 1977 & 1986).

3.0 Conservation Measures Taken

The Republic of Philippines has an elaborate system of protected areas—at least in paper—with about 60 "reserves" accounting for about 1.3 million ha. Many of these reserves lack the money, material and manpower to be effective in achieving their stated conservation goals.
Fig. 1 Map of the Philippines archipelago showing the location of Mindoro Island.
Fig. 2 Distribution of Tamaraw in Mindoro Island
As far as the Tamaraw is concerned, conservation measures date back to the turn of the century when two areas in Mindoro island were set aside especially for its conservation. These were the F.B. Harrison and the Calavite reserves established in 1920. Despite this wise, early action however, the Tamaraw continued to decline in number even within these areas owing to the activities of man (e.g. large scale poaching and habitat destruction).

Concerned by the decline, in 1930 the Government enacted the Commonwealth Act No 73 which banned all further hunting of Tamaraw.

Legal protection alone could not arrest the decline in the number of Tamaraw in the absence of diligent enforcement of law and order. The decline in Tamaraw numbers became alarming. In 1900, there were about 10,000 animals (Harrison 1969). By 1945, the number had declined to 1,000 and in 1953 a survey revealed that there were only 244 animals left in the Mt. Iglit Forest Reserve (Petocz 1988).

Given this situation, the Government established the 9,000 ha Mt. Iglit area as a Game Reserve in the 1960’s.

In 1965, the IUCN listed it as an endangered species.

In 1970 concerned by the grim prospects facing the Tamaraw, the Government expanded the Mt. Iglit Game reserve from 9,000 ha to 75,000 ha by linking it up with the Bacol reserve and created the Mt. Iglit-Baco Reserve by the Republic Act 6148 (Petocz 1988).

In 1970, the Mt. Iglit-Baco reserve was upgraded to the status of a National Park and in 1979, the Tamaraw Conservation Programme (TCP) was set in motion by the Government. Between 1979 and 1985, the management of the TCP was contracted out to the Special Commission for the Conservation of the Tamaraw (PCCT) and from 1985 to 1989, this role was taken over by the Conservation Resource Management Foundation, Inc. (CRMF) (Cox & Woodford 1990).

In 1982, the Mt. Iglit-Baco National Park was chosen as one of the ASEAN Heritage Sites.

In 1980, concerned by the continuing decline in the number of Tamaraw, the Government of the Philippines started what was then known as the “Gene-pool” programme in which Tamaraw were captured in the wild for breeding in captivity. The captive breeding facility was established within an area of 282 ha in the Mt. Iglit-Baco National Park near Canturoy in Mindoro Occidental. Animals were captured in pit traps and by 1989, there were 16 Tamaraw in captivity (CRMF 1990). Mortality had been high – at least 9 animals were known to have died since the capture programme started.

4.0 Conservation Measures Proposed

The three areas where Tamaraw occurs in the wild in Mindoro Occidental, if properly managed and manned would provide a firm basis for the effective protection of Tamaraw in the Philippines. Continued efforts to prevent further deterioration of Tamaraw habitats brought about by irresponsible human activities such as shifting cultivation, logging and cattle ranching and the eradication of poaching still remain a high priority.

The Mt. Iglit-Baco National Park with its 75,000 ha area and an altitudinal range from 400–2,400 m provides the best habitat that can support a viable Tamaraw population. There are plans to improve the current management of this National Park with the view to demarcate a core wilderness area in which the Tamaraw could survive free from human disturbances that pose a serious threat to its survival elsewhere.

Dr Ronald Petocz, a Biologist working for the WWF has already drawn up a proposal to improve significantly the Mt. Iglit-Baco National Park (see Petocz 1988) which also addresses the demarcation of park boundaries, establishment of a sound buffer-zone project, drawing up appropriate patrol systems for the guards, manpower development and training, and is backed up by a campaign to enhance the public awareness of the plight of the Tamaraw and its habitat.

Given the history of the Tamaraw in Mindoro, the animals appear to have co-existed with the domestic herds of carabao or water buffalo (Bubalus bubalis), the Tamaraw are susceptible to such virulent diseases as rinderpest, foot and mouth diseases that can be transmitted via the
domestic cattle (Cox & Woodford 1990). Rinderpest could easily wipe out such a localised population of Tamaraw. Therefore Cox and Woodford (1990) propose the vaccination of all the domestic cattle and carabao against such diseases as a precaution.

The Tamaraw Breeding Programme faces a number of problems ranging from difficulty of access during the rainy season (between May and November), to damage to the area and facility caused by fire during the dry season and floods in the rainy season, deacls in operational funds reaching the facility and armed aggression by bandits as well as the New People's Army (Cox & Woodford 1990). In view of these constraints, it is proposed to relocate the captive breeding facility from its present location in Mt. Iglit-Baco National Park to the University of the Philippines at Los Banos where the programme could be carried out under the auspices of the on going Carabao Research and Development Centre (CRDC).

Habitat protection is in fact the easiest and cheapest and most effective way of saving a species (MacKinnon & MacKinnon 1990). Unfortunately, there is no effective protection of even the well-known Tamaraw habitat in the Mt. Iglit-Baco National Park (Cox & Woodford 1990). Therefore, the protection of Tamaraw's natural habitat must always remain the highest priority as it would mean the conservation of not only the Tamaraw but other sympatric species as well.

A factor that is of even greater importance for the conservation of the Tamaraw than the improvement and protection of its habitat is the need for the Government of the Philippines to develop and implement conservation strategies that take into consideration the interests of the local people such as the Tabuid where have been sharing the habitat with the Tamaraw for centuries in the past.

As Kingdon (1988) points out an essential cornerstone of any successful nature conservation is the availability of an informed populace. Philippines has such an informed public with a literacy of 90%. However all the country's gains from such high literacy are being undercut by the country's human popula-

tion of over 60 million is the highest among the ASEAN countries and is growing at an annual rate of 2.8%. At this rate, it could double within the next 35 years. Therefore, if the Tamaraw is already under considerable threat from man, its status in three decades could only become much worse if its habitat is allowed to be encroached by man.

With the current estimated forest cover of only 21%, deforestation is probably the most serious environmental debility that has taken hold of the Philippines. According to Petocz (1988) "widespread, uncontrolled logging has so ravaged the country that hardly an island with an exploitable forest has remained untouched". Despite the laws enacted to prevent illegal extraction of timber, illegal logging still is a lucrative trade. In spite of a 1986 ban on log exports, Philippines earn about US$ 100 million a year from illegal logging in addition to the US$ 350 million from legal forest product exports (Alyanan 1990).

In view of the grim situation facing the Tamaraw in the Philippines, surveys are still needed to establish the size and location of Tamaraw populations in Mindoro island. Such surveys would be productive if they are carried out as recommended by Cox and Woodford (1990) in the Mt. Iglit-Baco National Park, Mt. Calavite Tamaraw Reservation, Mt. Halcon-Eagle Pass and the Aruyan-Sablayan area of Western Mindoro (Fig. 2).

However, in the final analysis, scientific and technological expertise alone is not sufficient if the money and resources required to implement this expertise are absent (Soule & Wilcox 1980). International philanthropy towards the Philippines — one of the poorest countries in Southeast Asea has been to date concerned more with extraction of resources than improving the lot of the poor through the establishment of sound, sustainable development programmes. Until this equation is balanced in favour of the local people, all conservation efforts would at best prove to be of only short term significance.

In the Philippines many wildlife populations have become dangerously low in size, and in some cases, have already become extinct during the past 25 years or so (Rabor 1978). In Min-
5.0 Species Account

Philippines is characterised by high level of endemism and biological richness (Petocz 1988). But the Tamaraw is the only wild cattle that is found in the island of Mindoro.

Tamaraw (Bubalus mindorensis)

5.1 Distribution & Population: Restricted to the island of Mindoro Occidental where small populations are known from Mt. Igli-Baco National Park, Mt. Calavite Tamaraw Reservation, Aruyan-Sablayan and perhaps Mt. Halcon-Eagle Pass. In 1987, the CRMF estimated that there were 356 animals in the wild (Petocz 1989) of which the largest comprising about 145 animals was in the Mt. Igli-Baco National Park giving a crude density of 0.19 per km². However, these estimates must be regarded at best as tentative as they were based not on detailed surveys but rather on the information provided by local people.

5.2 Status: The status of the Tamaraw was good prior to the World War II when hunting was carefully controlled (Anon 1983). Since then however, population growth and the attended evils of poaching and habitat encroachment have led to the Tamaraw being confined to smaller patches of habitat that are surrounded by an inhospitable landscape dominated by man. The ready availability of guns and ammunition and the general lawlessness of the warring factions in the country mean that the current status of the Tamaraw is one of extreme endangerment.

5.3 Habitat, Food & Reproduction: In the past, the Tamaraw had a much wider distribution in Mindoro island being common at all altitudes from sea level to the top of the mountains. The only requisites for its survival appear to be a supply of water for drinking, grasslands for grazing and patches of forest for resting. Unlike the buffalo, it is not known to bathe nor wallow (Walker 1975). It is a fairly adaptable species that can survive in an area as long as there is no human disturbance. The present habitat of the Tamaraw is not one of choice but of circumstances and reflects human pressures rather than animal’s preferences (Anon 1983). Tamaraw can feed on the young shoots of Imperata cylindrica (cogon grass) and Saccharum spontaneum (tehalib) following a burn. Once these grasses grow tall in the rainy season, the animal switches to a diet that is largely composed of bamboo shoots and water plants. Usually only one young is produced after a gestation period of 276–315 days (Walker 1975). The Tamaraw may live up to 25 years.

6.0 References


HOW WILD RELATIVES OF LIVESTOCK CONTRIBUTE TO A BALANCED ENVIRONMENT

By Jeffrey A. McNeely
Chief Conservation Officer
International Union for Conservation of Nature
and Natural Resources
1196 Gland, Switzerland

INTRODUCTION
As one of the most ancient cradles of human civilization, Asia is also home to many of the wild relatives of today's most important domestic livestock. Table 1 lists 22 wild species which are either close relatives (in the same genus) as domestic livestock, or are raised in captivity in a domestic form of the same species (elephant, pig, camel, buffalo, yak, banteng).

Yet many of these species are being severely depleted as human influence extends into even the most remote areas. IUCN considers no less than 14 of these 22 wild species to be threatened. The depletion of the wild relatives of livestock should be of considerable concern to those concerned with improving agricultural productivity in Asia. This paper briefly describes some of the resources available, states why they are important for development, and suggests several major steps that could be taken by livestock management agencies to ensure that the important contributions of these resources can continue far into the future.

LIVESTOCK, BIOLOGICAL RESOURCES, AND THE ENVIRONMENT
The wild relatives of livestock are important to the region economically, socially, and ethically. Focussing here on the practical side, wild relatives can contribute to agricultural productivity through direct capture and domestication, and through breeding. The general point is that animals which are already adapted to a particular environment are the first ones to turn to when seeking to improve the livelihoods of rural people; they are often harder than imported breeds and can survive on locally-available forage rather than on expensive feeds. Local people are already well aware of this, and both harvest wild species and often allow their domestic stock to breed with their wild relatives.

Modern technology is enhancing the potential contributions that wild relatives of livestock can make to human society. The techniques of embryo transplants, embryo splitting, and artificial insemination are now sufficiently well developed to enable wild relatives to make a real contribution to the livestock industry. Because embryos are free of many diseases, they can be shipped between nations without expensive quarantine precautions; and cryopreservation methods enable tiny bundles of cells to be sent by air in small insulated containers at little expense (National Research Council, 1983).

Other techniques, particularly genetic engineering, may soon be available to release the full potential of some of the wild relatives of livestock. The ability to produce new genes into the germ line of an animal and thereby produce proteins outside their normal environment has significantly improved both daily weight gain and feed efficiency, but has also led to a higher incidence of gastric ulcers, arthritis, cardiomegaly, dermatitis, and renal disease (Pursel, et al., 1989). Genes from wild relatives may provide the raw material for dealing more effectively with such genetic engineering challenges.

Perhaps more important, the new technology has significant implications for conservation because the wildlife genes will have increased commercial utility. A new economic incentive for conservation of native animals would become available, and livestock breeders would
have a vital stake in protecting species in the wild (Vittemeyer, 1983). The following are some of the possibilities:

The elephant. The elephant has long held a special place in the heart of Asian people. A symbol of wisdom, strength, and gentleness, the elephant has been used as a work animal for well over a thousand years, in forestry, as a transport animal, for religious purposes, and as a war machine. Ranging from India and Nepal to northern Borneo, about 30,000 to 45,000 elephants survive in the wild (compare with about 600,000 African elephants).

In many parts of tropical Asia, elephants trained for work in forestry are vital in developing valuable teak and other forests in rough hilly areas. Nearly 12,000 are held in captivity, including 5,400 in Burma, 3,500 in Thailand, 2500 in India, 600 in Vietnam, and 500 in Sri Lanka (Santiapillai, in press). The great majority of work elephants are still captured from the wild, but as the population of wild elephants is reduced, the supply will certainly become tighter and an important resource could be lost.

Conserving the elephant as a productive livestock resource requires several distinct activities: first, gathering the available information about captive elephant management to produce an authoritative manual on the subject; second, greatly improving the management of the captive herd with a view to reducing the demand on wild elephants, using technologies such as artificial insemination; third, identifying all major remaining wild elephant herds and monitoring their status; and fourth, managing the wild elephant herd through maintaining sufficient habitat. The last step will require that a far broader approach to habitat management be taken, involving a range of different protective regimes (McNeely, 1978).

Wild pigs. Several species of wild pigs occur in various parts of Asia, often in very high populations; they are often the most common large mammal in the forested regions. The harvesting of wild pigs in Sarawak, for example, has an equivalent market value of M$100 million per year and Bearded Pigs represent the single most important source of meat (Caldecott and Caldecott, 1985). A more distant relative, the Babirusa (Babyrousa babyrussa), occurs in Sulawesi and a few surrounding islands.

The common farm pig is a domesticated version of the Wild Pig found throughout much of Eurasia, while the domestic pig of New Guinea is a hybrid between the Common Wild Pig and the Sulawesi Wild Pig. The wild pigs appear to be resistant to many diseases that affect domestic pigs; they can survive on rougher forage, and produce leaner meat. In many parts of tropical Asia, domestic sows are allowed to wander in forests in hopes that they will cross-breed with wild boars.

Genetic engineering could be particularly important in bringing the benefits of the Babirusa to the other pigs; because its stomach resembles that of a ruminant instead of the other pigs, the Babirusa is thought to be able to make more efficient use of grasses and other low-quality feeds. Hybrids between Babirusa and domestic pigs may therefore be able to prosper on much less expensive feed than is required for today's farm pigs.

Wild sheep and goats. The world's centre of diversity for wild sheep and goats is in the mountains of central Asia, where three goats and two sheep occur (with numerous subspecies), along with more distant relatives such as the Blue Sheep Pseudois nayaur (which supports an annual export of 100,000 to 200,000 kg of meat from China's Qinghai Province, mostly to western Europe — Schaller et al., 1988), Takin (Budorcas taxicolor), Tahr (Hemitragus spp.), Serow (Capricornis spp.), and Goral (Nemorhaedus goral). The Altai Wild Sheep is the largest of all sheep, sometimes weighing over 250 kg.

The Central Asian wild relatives of goat and sheep have been well studied by Schaller (1977), who called for a network of relatively unmodified areas to be established. "Some day man may want to rebuild what he has squandered," Schaller said, "and from such samples of original habitat he can then not only draw genetic stock but also learn how the ecological pieces have adjusted to create a harmonious system." But Schaller also recognized that governments need to develop integrated programmes of forest, range, and wildlife management, involving local people whenever and enabling the wild ungulates...
to increase in certain parts of each management unit until they become abundant enough to be harvested.

The wild relatives of sheep and goats can make very significant contributions to human welfare. They tend to have much leaner meat than their domestic cousins, a higher proportion of edible protein of live weight, and higher percentages of usable protein in their meat. Further, many of the wild forms have extremely valuable characteristics, such as marked sexual dimorphism; with larger males and smaller females, less biomass of breeding females needs to be maintained on the annual forage (which is often severely limited in winter) while still maintaining the ability to produce productive offspring. Crosses between wild and domestic forms of sheep in the US have been able to increase their efficiency in converting plant food energy to edible meat protein by about 50 percent. Wild sheep also produce more young than do domestic sheep, with the Urial having an effective reproduction rate as high as 1.5 lambs per ewe.

Wild cattle. Tropical Asia is the home to all remaining wild relatives of domestic cattle. Banteng, Gaur, and Kouprey are all greatly favored abandoned clearings and have long been closely linked to shifting cultivation (Lekagul and McNeely, 1975). All three species are extremely rare, with Kouprey numbering in the hundreds, Gaur in the low thousands, and Banteng in the middle thousands; no accurate population surveys have been conducted. Conserving these species would appear to be feasible, as at least Gaur appear to prosper in areas adjacent to major agricultural development projects and logging operations, provided they are not harassed by hunters (Conroy, 1989).

The Yak is quite a different sort of bovid, being adapted to the high-altitude grasslands of the Tibetan Plateau into Sinkiang, Pakistan, Afghanistan, Mongolia, and the USSR. Only a few hundred Wild Yaks survive, primarily in Tibet, where sparse grass and bitter winter cold somehow enable the black Wild Yaks to grow to 2 meters at the withers (among the largest of all bovids). The smaller domesticated version supports human society in the mountains of Central Asia, producing meat and milk (which is much richer than cow's milk and produces butter used as a food staple and as a lighting fuel) as well as hair for clothing, rope, and blankets and skin for rugs, shoes, and shelter; its dried dung is used for fuel in treeless areas. As a beast of burden, yaks can carry loads of 150 kg and pull a plow for high-altitude barley fields.

In areas where wild Yaks still occur, they sometimes crossbreed with the domestic forms. Crosses of various sorts between yaks and domestic cattle (Sherpas have names for at least eight different hybrids) have improved characteristics such as quality of milk, hardiness in high altitudes, and resistance to cold. But in order to maintain the genetic value of the Wild Yaks, they need to be fully protected against accidental hybridization; and they are so severely threatened by hunting that strict protection measures are essential.

The Wild Water Buffalo still occurs, though in very low numbers, in a few parts of India and possibly in western Thailand (Lekagul and McNeely, 1975); the riverine grasslands where this species thrived have now been taken over for agriculture, leaving insufficient habitat to support the species. Most of the remaining animals have interbred with feral buffalo, thereby losing at least some of their genetic distinctiveness; considerable feral populations occur in northern Australia, Sri Lanka, and Burma. The closest relatives of the buffalo are both browsing animals. The Tamaraw of the Philippines is highly endangered, with only an estimated 369 individuals surviving (Petocz, 1989); and the two species of Anoa occur in Sulawesi, in far larger populations than the Tamaraw.

All of the wild cattle are important to the livestock industry. Most of them may have crossed with domestic cattle at some time in history; cattle-banteng crosses are common in Indonesia (the famous Madura cattle are such hybrids), and the Mithun of Burma is thought to be a cross between Gaur and domestic cattle. Most of the wild boids can develop large, muscular bodies while grazing and browsing on vegetation that would not support cattle. Banteng have short hair and tough hides; and appear to be more resistant to external parasites than are
domestic cattle (National Research Council, 1983). Kouprey are thought to be at least partially resistant to rinderpest. Other advantages of cross-breeds between wild and domestic cattle include feed efficiency, thriftiness, heat tolerance, carcass quality, external fat thickness, and intelligence (National Research Council, 1983). Taming the wild cattle also has considerable potential, particularly in remote areas where predators such as tigers and leopards are still a problem; the wild cattle are effective protectors of their young. However, they have little defense against habitat destruction and human hunters.

SPECIFIC STEPS THAT MINISTRIES OF AGRICULTURE CAN TAKE TO HELP CONSERVE WILD RELATIVES OF DOMESTIC ANIMALS

Many of the actions required to conserve the wild relatives of domestic livestock are beyond the mandate of livestock agencies. For example, it is the ministries of planning who are responsible for ensuring that all national land-use plans include the habitat requirements of the wild relatives of domestic animals. They also are responsible for developing the policies that would promote maintaining natural vegetation in mountainous or hilly terrain, connecting protected areas with corridors of natural habitat, and actively managing the populations of endangered wild relatives. But the interests of the livestock industry are so closely tied to the welfare of the wild relatives that a serious response by the livestock sector is required. The following actions might be considered:

1. Ministries of Agriculture should take a greater concern about the wild relatives of livestock, with a view to using such forms to improve the welfare of rural people. This concern should be expressed in terms of an expanded research and development effort for the wild relatives of livestock, including investigating possibilities for domestication, direct harvesting, cross-breeding, and inclusion in multiple-species grazing systems.

2. New programmes in support of conserving wild relatives should be developed by Ministries of Agriculture and supported by international development agencies. Aimed specifically at the human population in the most remote areas which are least accessible for most forms of development assistance, these programmes should include new incentives which will promote the conservation and sustainable utilization of wild relatives by farmers.

3. FAO should consider a regional project which would investigate the present and potential role, productivity and efficiency of all wild relatives of livestock, including assessing the economic importance of these species.

4. International cooperation in conserving the wild relatives of livestock should be enhanced. Virtually all species move freely across international borders, so they are a shared resource requiring coordinated action. An excellent example is the Kouprey Action Plan agreed among the relevant governments, zoos, and international conservation organizations with the goals of saving the Kouprey in the wild and determining whether the Kouprey can be used to benefit the livestock industry (MacKinnon and Stuart 1989). The agreed objectives include securing and protecting suitable areas of Kouprey habitat in each country (Laos, Vietnam, and Kampuchea); building up a strong, effective local team for managing the Kouprey in each of the countries concerned; and establishing a captive population of Kouprey as a means of ensuring the protection of the gene pool, accelerating the recovery of the wild population through a programme of reintroduction, and undertaking trials in Kouprey domestication and hybridization.

5. Viable captive herds of all species and subspecies of wild relatives should be established, for captive breeding, public education, research, and demonstration. Zoos and ministries of agriculture should collaborate in this effort, supported by international development agencies.

CONCLUSION

The wild relatives of domestic livestock are an exceedingly important, but under-utilized biolo-
The preparation of this paper is part of IUCN’s effort to conserve the world’s biological resources. Its preparation has been supported by the Government of Switzerland, as part of a global programme being conducted by IUCN in cooperation with the United Nations Environment Programme and the World Resources Institute. My thanks to Paul Wachtel and Peter Jackson for comments on an earlier draft.

* This paper was originally prepared for the anniversary issue of ASIAN LIVESTOCK.

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**Table 1. ASIAN WILD RELATIVES OF LIVESTOCK**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Latin name</th>
<th>Range</th>
</tr>
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<tr>
<td><em>Asian elephant</em></td>
<td><em>Elephas maximus</em></td>
<td>India to Indonesia</td>
</tr>
<tr>
<td><em>Wild horse</em></td>
<td><em>Equus przewalskii</em></td>
<td>Mongolia, China</td>
</tr>
<tr>
<td><em>Wild ass</em></td>
<td><em>Equus hemionus</em></td>
<td>Iran to China and India</td>
</tr>
<tr>
<td>Wild pig</td>
<td><em>Sus scrofa</em></td>
<td>Europe to Indonesia</td>
</tr>
<tr>
<td>Bearded pig</td>
<td><em>Sus barbatus</em></td>
<td>Malaysia, Sumatra</td>
</tr>
<tr>
<td>Warty pig</td>
<td><em>Sus verrucusus</em></td>
<td>Java</td>
</tr>
<tr>
<td>Sulawesi pig</td>
<td><em>Sus celebensis</em></td>
<td>Sulawesi</td>
</tr>
<tr>
<td><em>Pygmy hog</em></td>
<td><em>Sus salvanius</em></td>
<td>India, Nepal</td>
</tr>
<tr>
<td><em>Bactrian camel</em></td>
<td><em>Camelus bactrianus</em></td>
<td>Mongolia, China</td>
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<tr>
<td>Ibex</td>
<td><em>Capra ibex</em></td>
<td>Afghanistan, Pakistan</td>
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<tr>
<td><em>Markhor</em></td>
<td><em>Capra falconeri</em></td>
<td>W. Himalayas</td>
</tr>
<tr>
<td>Wild goat</td>
<td><em>Capra aegagrus</em></td>
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<td>Wild sheep</td>
<td><em>Ovis ammon</em></td>
<td>C. Asia, Himalayas</td>
</tr>
<tr>
<td>Urial</td>
<td><em>Ovis orientalis</em></td>
<td>Pakistan</td>
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<td><em>Wild buffalo</em></td>
<td><em>Bubalus bubalis</em></td>
<td>India to Thailand</td>
</tr>
<tr>
<td><em>Lowland anoa</em></td>
<td><em>Bubalus depressicornis</em></td>
<td>Sulawesi</td>
</tr>
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<td><em>Bubalus mindorensis</em></td>
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<td><em>Bos grunniens</em></td>
<td>China, Mongolia</td>
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<td><em>Bos gaurus</em></td>
<td>India to Peninsular Malaysia</td>
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<td><em>Bos javanicus</em></td>
<td>SE Asia, Java</td>
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<tr>
<td><em>Kouprey</em></td>
<td><em>Bos sauveli</em></td>
<td>Indochina</td>
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REFERENCES


