Part 4

FERAL ANIMALS
PROBLEMS AND POTENTIAL

A group of Feral Spanish Mustang horses

Part 4 introduces, for the first time, the issue of feral populations associated with Domestic Animal Diversity. In explaining that feral populations, by definition, are derived from previously domesticated stock, the section expands on the potential costs and benefits of feral animals. Species covered include goats and sheep, through cattle and buffaloes to horses, with examples from Australasia to the Americas.

Exploring issues related to the impact of feral organisms on the environment, the use of management practices, especially hunting, to limit harmful impacts and gain some economic and nutritional benefits is discussed. The value of the resource for genetic diversity and the means of assessing this potential are included.

More detailed documentation of these feral populations and their links to Farm Animal Genetic Resources will be provided as the Global Strategy for the Management of Farm Animal Genetic Resources is further developed.

For the purposes of this publication, animals are considered to be feral if they, or their ancestors, were formerly domesticated but are now living independently of humans. The terms feral and introduced are often confused, although their respective meanings are quite distinct. Feral animals may be introduced and exotic to the area in which they occur, but need not be so. Similarly, introduced species need never to have passed through a domesticated phase and those that have not, should not be referred to as feral.

For example, the free-living Asian buffalo in northern Australia represent a feral population of an introduced species whereas the red fox (*Vulpes vulpes*) in the same country is not feral although it was introduced.

Distinguishing feral populations of introduced species from feral but indigenous animals is of great importance because the account taken of both their potential value and of the problems they may cause can be very different.

Feral animals are often regarded as a serious problem, but what is less appreciated is that they may also be a valuable resource.

TABLE 4.1. POTENTIAL PROBLEMS AND POSSIBLE BENEFITS ASSOCIATED WITH FERAL ANIMALS

PROBLEMS

- genetic introgression into contiguous wild populations;
- environmental modification;
- competition with wild species and/or domestic livestock;
- disease risk to wild species or domestic livestock;
- expensive management;
- public disapproval.

BENEFITS

- maintenance of ecosystem integrity;
- genetic resource;
- economic value;
- cultural importance;
- research potential.

Several of the entries in Table 4.1 are self-explanatory, but others require further comment.

PROBLEMS

The problem of feral animals interbreeding with their wild conspecifics is generally one that occurs when the feral animals in question belong to a species indigenous to the area. It is possible, however, for feral individuals of an introduced species to interbreed with members of a different, but closely related, indigenous species.

Undesirable environmental modification brought about by the activities of feral populations, both indigenous and exotic, can present a serious problem. The destruction or harmful modification of the habitats of native flora and fauna is a widely recognised consequence of the presence of exotic species.

The well-documented ecological impact of feral Asian buffalo in northern Australia provides many good examples of the profound environmental changes that can be caused by an introduced feral species. Feral populations of indigenous species can also cause similar problems, but this is only likely to be the case when the population density is unusually high.

Large herds of feral buffalo in northern Australia have overgrazed areas close to water and have almost eliminated the water couch plant (*Hymenachne sp*.). This plant forms the living fabric of the swamp, being grazed by native animals and forming huge floating rafts used by crocodiles, birds and other small animals for nesting. The rotting vegetation is also a source of food for many small aquatic animals. Other plants, such as the giant reed *Phragmites*, are seriously depleted by the buffalo, leaving the trampled soil exposed to erosion by rain in the wet season.

The swimming and wallowing habits of the buffalo have also had a devastating impact on low, sub-coastal wetlands. During the wet season buffalo use regular routes to swim and walk between the high ground where they graze. This behaviour pattern breaches naturally formed banks and creates deep channels that remain as permanent canals. The damaged banks and canals allow the invasion of salt water from high tides during the dry season, altering the salinity of the wetland. The persistent flow of tidal salt water also accelerates the erosion process.

It has been suggested that feral Asian buffalo in Java are a threat to wild banteng (*Bos javanicus*), both as competitors for food and as a source of disease. In Australia, feral Asian buffalo are controlled in an attempt to eradicate bovine tuberculosis and brucellosis.

In almost every situation where they occur, especially on islands, feral populations of domesticated animals are considered to be pests. They compete with wildlife, including their wild relatives, and with domestic livestock for food and shelter, threaten native fauna and flora, contribute to erosion and can also transmit or act as reservoirs of disease organisms.

Feral goats in Australia exert a great influence on native vegetation and compete with native wild animals for food and shelter. One of the possible reasons that the yellow-footed rock wallaby (*Petrogale xanthopus*) is rare in its former range in western New South Wales is that it is forced out of rock shelters by feral goats. Rock wallabies are heavily preyed upon by wedge-tailed eagles (*Aquila audax*) and require rock overhangs and caves for shelter from aerial predators and from the heat of the day. Feral goats also compete with domestic stock for pasture, especially during drought. Another problem for domestic stock is that feral goats often carry footrot, making it difficult to eradicate this disease from sheep where the goats are present.

In the Himalayas feral goats may transmit the virus of *peste des petits ruminants* to their wild relatives (Wood and Barrett, 1979).

In the United States of America, in places where feral pigs are not controlled by man or large predators, they multiply rapidly and cause considerable environmental damage by rooting in the soil. Feral pigs, which occur in at least 18 States, are susceptible to swine brucellosis and to pseudorabies, both important diseases of domestic pigs with which they may come into contact (Wood and Barrett, 1979; Animal and Plant Health Inspection Service, 1995).

In Australia, feral pigs, which occur from western Victoria through New South Wales and Queensland and across northern Australia from Cape York to the Kimberley Mountains in Western Australia, are the most serious agricultural pests. Pigs eat and damage crops and pasture. They have a serious adverse impact on the natural ecosystem. Their habit of rooting and wallowing around the margins of swamps and watercourses can destroy the vegetation that prevents erosion and provides food and nesting sites for native wildlife. Feral pigs may prey on lambs and damage fences. Up to 40 percent of lambs are said to be killed and eaten by feral pigs in some areas. However, the greatest threat the feral pig poses to agriculture in Australia is its potential to carry exotic diseases such as foot and mouth disease and swine fever (both classical and African), in a country where these notable diseases do not occur as yet. The feral pig is also a potential host of the screwworm (*Cochliomyia hominivorax*).

Feral horses and asses (burros) have been present in the United States of America since the 1850s. They represent one of the most complicated contemporary wildlife management problems in the western United States (Howard and Marsh, 1982). Most of the feral (often called wild) horses are to be found on public lands in Nevada, but other states with more than 1 000 individuals are California, Colorado, Idaho, Montana, Oregon and Wyoming. The major feral burro distribution is in an area comprising mostly public lands in south-eastern California, southern Nevada, southern Utah and western Arizona. About 95 percent of all the wild horses (+/ 45 000) and burros (+/- 12 000) occur on federal land administered by the Bureau of Land Management (BLM) of the Department of the Interior (USDI).

In some areas of California feral burros have caused devastating damage to the vegetation and have seriously affected the native flora and fauna. They have caused soil damage, accelerated erosion, vegetation destruction, spring and water hole disturbance and have competed with native wildlife for food, water and living space (Sanchez, 1974).

In Australia, the Northern Territory alone has approximately four times as many feral horses (brumbies) as there are in the entire United States of America. There is considerable dietary overlap between horses and cattle in the types of grasses eaten and they are regarded as being in direct competition. Brumbies are also said to cause significant damage to fences.

The ass thrives in areas unsuitable for horses and cattle and since they graze further away from water they can have a much wider impact on native vegetation. Asses are believed to congregate around remaining watering points during times of drought and to prevent cattle from drinking. They also foul watering points, to the detriment of other species. On the Arabian Peninsula, where the ass as a beast of burden has been largely replaced by the pickup truck, abandoned feral asses graze alongside main roads where the run-off encourages growth of vegetation. Asses have little road sense and motor accidents are frequent.

The management of feral animals can be very expensive, resulting in less money being available for the conservation of wild flora and fauna. Berger (1991) has calculated that for every US$ spent on feral horses and burros in the United States of America during the period 1980 to 1987 each of the 126 endangered species that also occurred on public lands received less than six cents. Money spent on managing feral animals for either economic or biological reasons may also be wasted if the methods adopted are ineffective, or if management is not actually necessary.

Public opinion may need to be considered too. Animal welfare groups may object to the control or elimination of feral populations. Many people find it hard to accept that animals in poor condition and dying of starvation could be part of a natural process of selection and that it is necessary to adjust the population to the carrying capacity of the range. Such concerns lead to demands that the animals be given supplementary food; for example, feral buffalo in Baluran National Park in East Java were provided with cut grass despite a concurrent programme to reduce the population.

Local people may have an economic interest in the preservation of feral populations which conservationists may wish to control or eradicate in order to protect wild flora and fauna. In Australia, a mutually satisfactory solution to this problem has been established whereby Aboriginal landowners derive both sustenance from the large numbers of feral Asian buffalo and banteng which occur there, and financial benefit through the sale of hunting permits. This has been successful, despite the fact that these animals are otherwise controlled because of their considerable impact on the ecology of the area (Bowman, 1993).

Alternatively local people, particularly farmers, may want feral animals removed or eradicated because they are agricultural pests or because they compete with livestock, while conservationists may want to conserve the same animals because of their perceived genetic or ecological value.

BENEFITS

Feral animals can play the same ecological role as their wild relatives in helping to maintain the functional integrity of the ecosystems in which they occur. Furthermore, a well-established feral population is likely to be better adapted to its environment than an introduced wild one. There is always the possibility, however remote, that the original wild population in a given region might have belonged to a now extinct subspecies and that those animals might have been the ancestors of the present feral population. Thus some feral populations may be both functionally important and genetically valuable because they may contain genetic material which has been lost from the wild gene pool.

Feral animals are also a valuable genetic resource in their own right. Van Vuren and Hedrick (1989) argue that populations of feral livestock may have two important attributes that are of significance for genetic conservation (Table 4.2):

Firstly, feral animals may possess relict characteristics or genetic variants that are either absent in modern domestic stock or exist only in rare breeds. These traits may be of commercial, scientific, aesthetic or historical value. The feral cattle on Swona in the Orkney Islands, United Kingdom, which may be descendants of an unusual breed of triple-use stock (used for meat, milk and draught) (Hall and Moore, 1986) are one example. Another is the Chillingham herd of White Cattle in the United Kingdom, which were previously thought to be wild descendants of the aurochs, but are now generally regarded as feral (Baker and Maxwell, 1981; Hall and Hall, 1988; Corbet and Harris, 1991).

Secondly, feral animals may have novel and/or rare characteristics or adaptations. Such traits may include adaptations to extreme environmental conditions (e.g. temperature stress, drought and high parasite load), either as a result of selection pressures that have led to an increase in the frequency of rare genetic types, or mutation, or both.

Feral horses are not known to possess genetic features that are not found in domestic individuals. The selective pressures they have endured in the wild, however, are likely to be shaping them genetically, producing a hardier stock which may prove to be a useful genetic resource in the future (Mason, 1979; FAO, 1980). Against this, in Australia it is said that feral horses tend to lose the conformation desirable for domestic horses, developing small bodies with big heads and short necks.

Genetic introgression from wild, other feral, or domestic populations, followed by recombination, selection, genetic drift, or some combination of these may have been of importance in accruing novel traits (Van Vuren and Hedrick, 1989). The presence of such traits in feral populations may potentially be of great commercial and scientific value. Feral populations may exhibit both relict and novel attributes.

Some feral species have great economic significance. Feral Asian buffalo have potential value as a source of meat and revenue from hunting. Domestic Asian buffalo were imported into northern Australia in the first half of the nineteenth century and many were set free. They spread and multiplied in the absence of any large predator to control them. In 1985 it was estimated that there were 350 000 feral buffalo in the Northern Territory and Queensland. About 20 000 are harvested for meat and many redomesticated animals have been exported to Papua New Guinea, Venezuela, Nigeria and Guyana.

Redomesticated animals may be of actual economic importance irrespective of whether they possess valuable genetic characteristics. In Australia, feral Asian buffalo are currently being captured and tuberculosis-free herds established (Boulton and Freeland, 1991). In Indonesia, feral Asian buffalo have been removed from at least one protected area and redomesticated. A similar project was instituted in Sri Lanka (Woodford, 1979).

The immediate economic value of feral animals is not limited to their redomestication. They can be a major tourist attraction and thus a source of revenue. Wildlife oriented tourism is becoming increasingly popular and for many people the sight of apparently wild animals of such impressive appearance as the Asian buffalo, the mithan or the yak will not be devalued by knowing that the animals are feral. Although one can expect indigenous feral animals to be of greatest interest to wildlife enthusiasts, feral animals of introduced species have proved to be an attraction too: Feral Asian buffalo feature in tourist promotions in the upper reaches of northern Australia, for example.

Safari hunting can be another source of revenue from feral animals. The Aboriginal owners of Gurig National Park in Australia receive about A$ 2 500 for each trophy-sized banteng bull and A$ 400 for each cow shot by big game hunters who come from all over the world (Bowman, 1993).

Feral pigs in the United States of America have become popular for sport hunting and are considered important game animals in California where commercial hunting/management programmes on private land have been successful (Howard and Marsh, 1984).

Feral animals may also be of cultural and historical importance. In the United States of America mustangs (wild or feral horses) symbolise the freedom of the West and many people are happy to let them occupy the niche formerly filled by truly wild equids, which became extinct in the New World some 10 000 years ago (Duncan, 1992). Bowman (1993) has argued that feral bovids in northern Australia are of great interest as a living reminder of the early colonial period.

Finally, populations of feral animals can be of great scientific value. Abundant feral relatives of endangered wild species can be studied using methods that would present an unacceptable danger to their wild counterparts. Such studies can produce much information of value for the conservation of the remaining wild populations. Much of what we know about the ecology and behaviour of the Asian buffalo is the result of research on the feral animals of Australia (e.g. Tulloch, 1969 *et seq*; Braithwaite *et al,* 1984; Taylor and Friend, 1984; Friend and Taylor, 1984). Several studies of feral banteng, also in northern Australia, have provided interesting data about that species (e.g. Bowman and Panton, 1991; Choquenot, 1993). Further, as Bowman (1993) points out, the large number of feral banteng in northern Australia presents biologists with an extraordinary opportunity to study the ecology and behaviour of an endangered bovid, an opportunity that has yet to be fully appreciated.

TABLE 4.2.
VALUABLE GENETIC ATTRIBUTES THAT MAY BE PRESENT IN FERAL POPULATIONS AND POSSIBLE INDICATORS OF THEIR PRESENCE

ATTRIBUTES	
Relict characteristics or genetic variants; novel or rare adaptations.	
INDICATORS	
DIRECT	morphological markers; quantitative traits; fitness enhancing characteristics; rare and unique alleles.
INDIRECT	generations since isolation; extent of isolation; number of founders; ancestral breeds; physical and biotic environment; management practices.

Source: *reproduced with modifications, from Van Vuren and Hedrick, 1989*

Van Vuren and Hedrick (1989) cite studies documenting potentially valuable traits present in feral sheep and pig populations in the United States of America. Unfortunately, the important feral bovid populations in Asia have been generally neglected and consequently their potential value is largely unknown. Feral Asian buffalo in Australia have been better studied and while their numbers have been much reduced in recent years as part of a disease control programme, a number have been redomesticated and these animals may possess useful characteristics.

How can one tell whether a feral population might contain important genetic traits? Indicators can be either direct or indirect (Table 4.2). Direct indicators are usually best and include morphological features that may indicate ancestry or adaptation such as hair colour, coat length or presence and shape of horns. Quantitative characteristics, including body size, degree of sexual dimorphism, litter size or duration of breeding season, may also indicate significant differences in ancestry or selection pressure. However, the possible confounding effects of environmental variation should always be kept in mind when considering the possible significance of quantitative or morphological traits. For example, small body size might be the result of a poor quality diet. Bison (*Bison bison*), although not feral animals, provide an illustrative example. In Canada, bison belonging to the putative wood bison subspecies (*Bison bison athabascae*) develop the characteristic coat of the plains bison (*B.b. bison*) when properly fed. Wood bison turn out to be an ecotype and an artefact of captivity rather than a valid taxon; *Bison bison* has no subspecies (Geist, 1992). Similar caution needs to be applied to the interpretation of other traits that might indicate valuable adaptations such as resistance to particular diseases or parasites: Low parasite load in feral populations may be due to a lack of the necessary intermediate hosts (Van Vuren and Hedrick, 1989). The reported absence of rinderpest and foot and mouth disease among Asian buffalo on Borneo probably owes more to the apparent absence of these diseases from the island than to any inherent resistance of the buffalo living there (Cockrill, 1968). Comparisons between animals from different populations clearly need to be conducted under controlled conditions.

Genetic markers can be useful indicators. The presence of rare or unique alleles in feral populations, determined using the fast-developing techniques of molecular biology, might indicate that those animals have a different ancestry to that of extant domestic stock. Alternatively, the differences may be due to a particular mutation that has subsequently increased in frequency as a result of selection and/or genetic drift. The absence of unique genetic markers, however, should not be taken to mean that the animals under investigation lack interesting or unique adaptive traits since it is generally assumed that biochemical variants are non-adaptive (Van Vuren and Hedrick, 1989).

Indirect indicators of possible genetic differences between feral populations and domestic livestock can also be useful and will very often be all that is available. A number of potential indicators are listed in Table 4.2.
The number of generations for which a population has been feral may indicate how likely it is that novel adapta-

tions will have evolved. The degree of isolation can be important too. If a population has been completely or almost completely isolated, many of the characteristics of its founders should be retained. However, as Van Vuren and Hedrick (1989) point out, isolation is not actually necessary. Interbreeding between feral populations and domestic animals need not lead to a change in the feral gene pool if the hybrid offspring do not themselves mate with feral animals.

The number of founders and the size of the population since the animals became feral can be useful indicators of the likelihood that the population is genetically significantly different from other feral populations and from extant breeds. If there were few founders and/or population size has been small for many generations, genetic drift may have led to the fixation of unusual characteristics. The history of the population can be important in other ways too. If it is known that a feral population was derived from a now extinct breed it may contain interesting and potentially valuable relict variants.

The environment can also be a valuable indicator of whether interesting genetic characteristics are likely to be present in a population. Both biotic and abiotic features may be important. For example, local climatic extremes may suggest that a population that has persisted in an area is adapted to temperature stress or drought conditions. Similarly, if a population apparently thrives in an area where a particular parasite or disease is known to be especially prevalent, one might expect that population to be more resistant than domestic (or other feral) animals not subjected to such selective pressures.

Finally, the management history of the feral population may also provide an indication of whether unusual traits are present. The persistence of relict characteristics, some of which may have originated as a result of deliberate selection for certain traits while the ancestors of a currently feral population were still managed domestic stock, has already been discussed, but management can also be influential after a population has become feral. Hunting practices, for example, may represent an important selection pressure. The small size of the feral Asian buffalo in Australia compared with those on the island of Timor, the source of many of the original imports, has been attributed to many years of hunting, during which large males were preferred targets (Cockrill, 1974).

Important as they may be, the genetic characteristics of feral animals are by no means their only valuable feature. Indeed, while many of the genetic traits discussed above are of potential importance, other attributes, such as economic worth, may be of far more immediate value.

It should be clear from the above discussion that feral animals have great economic and biological value, both potential and actual. It must be stressed, however, that when the management of a feral population is being considered the conservation of natural biodiversity should always take precedence. Although it is important to acknowledge that feral animals may play a key role in the functioning of ecosystems in which they occur and thus be of significance for the conservation of many other species, they can be very destructive. Feral populations will need to be assessed on a site-by-site basis, weighing their possible valuable attributes against the potentially serious problems often caused by their presence.

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ANNEX 4.1. SPECIES THAT HAVE GIVEN RISE TO FERAL POPULATIONS

ARTIODACTYLA	Wild Relatives	Domestic descendants
Bovidae	*Bos javanicus* (banteng)	Bali cattle
	Bos frontalis (gaur)	Gayal or Mithan
	Bos grunniens	yak
	Bos primigenius (EXTINCT)	cattle
	Bubalus bubalis (water buffalo)	buffalo
	Capra aegagrus (Bezoar or wild goat)	domestic goat
	Ovis orientalis	sheep
Camelidae	*Camelus bactrianus* (Bactrian camel)	Bactrian camel
	Camelus dromedarius (dromedary)	camel
	Lama guanacoe (guanaco)	llama and alpaca
Cervidae	*Rangifer tarandus*	reindeer
Suidae	*Sus scrofa* (wild boar)	pig

PERISSODACTYLA	Wild Relatives	Domestic descendants
Equidae	*Equus asinus* (African wild ass)	ass or donkey, burro
	Equus ferus (EXTINCT)	horse, brumby

PROBOSCIDEA	Wild Relatives	Domestic descendants
Elephantidae	*Elephas maximus*	Asian elephant

CARNIVORA	Wild Relatives	Domestic descendants
Canidae	*Canis lupus* (wolf)	dog, dingo
Felidae	*Felis sylvestris* (wild cat)	domestic cat
Mustelidae	*Mustela putorius* (polecat)	ferret
	Mustela vison (American mink)	mink

RODENTIA	Wild Relatives	Domestic descendants
	Cavia aperea	guinea pig
	Hydrochaerus hydrochaerus	capybara
	Chinchilla laniger	chinchilla
	Cricetus cricetus	common hamster
	Mesocricetus auratus	golden hamster
	Ondatra zibethica	muskrat
	Gerbillus spp. (gerbils)	gerbil
	Mus musculus (house mouse)	laboratory mouse
	Rattus norvegicus (Norway rat)	laboratory rat

LAGOMORPHA	Wild Relatives	Domestic descendants
	Oryctolagus cuniculus	rabbit or coney

from: Munton, Clutton-Brock and Rudge, 1984