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Farming non-domesticated and semi-domesticated terrestrial species

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Introduction

Domestication is a rather slippery term that needs definition. It is to be regarded not as a state of being, but as a process (Clutton-Brock, 1992). Price (2002) has defined this as “that process by which a population of animals becomes adapted to man and to the captive environment by some combination of genetic changes occurring over generations and environmentally induced developmental events recurring during each generation”. According to Price then, and as he identifies, domesticated animals include those invertebrates such as silkworms, oysters, prawns, and honeybees that have been bred and kept captive for our use. If it is agreed that domestication is a process and not a classification of types of species or subspecies, then any animal that is taken from the wild and used for farming over any cycles of generation can be considered to have begun upon the path to domestication. Nevertheless, the terms non-domesticated and partially domesticated are used here to distinguish animals that have been, over many thousands of generations, in close contact with humans (cattle, sheep, goats, and pigs) and those species that are kept for farming purposes but have either been kept for relatively few generations (the silver fox, the musk deer) or have been kept for farming purposes with a light touch of interference or captivity by their human owners (reindeer).

The animals discussed here, and their welfare, are less well studied and reported than other more traditional livestock. Our understanding of their needs and problems is therefore comparatively inadequate, and their requirements may well be different from those of other, better studied species. The rearing systems of these species are described, as well as known problems and how these might be ameliorated. Other problems that are a consequence of their management and that cannot easily be ameliorated are identified, and suggested extant methods to evaluate their welfare are presented.

There are more undomesticated and partially domesticated terrestrial animals that are farmed than are discussed here, such as yak, crocodiles, iguanas, guinea pigs, emus, and ostriches. However, these are of only localised importance and their market influence is limited in global terms, hence they are not considered here. However, it is important to realise that there are some major welfare concerns that are important to individual animals, for example rearing crocodiles in isolation to avoid blemishes on their skin. Invertebrates too are farmed, and can be considered domesticated, such as insects and snails for human food, but although the evidence for sentence
in some invertebrate species is growing, they are excluded here because they are not thought to suffer in the same way as vertebrate species.

**Fur-bearing animals**

Many production animals produce fibre or pelt products as an important part of their value to the farmer and to the market. Fur animals here are understood to be animals kept for the primary purpose of the production of fur. The production process, at least in Europe, is currently that the animals are bred and reared mainly in northern European countries (principally Denmark, Finland, Poland, Sweden, Lithuania, and Russia), their pelts are sold at auction, mostly at the Copenhagen fur market (Kopenhagen Fur), and the purchased pelts are used to make garments and accessories, commonly in Greece, from where they are exported all over the world. Outside of Europe fur production is important and increasing in China (Sha et al., 2011) and North America (Fur Commission USA, 2019) including Canada.

The legal approval for the farming of fur-bearing animals is changing rapidly, and this has had an impact on fur production numbers, at least in Europe. This has been exacerbated by the COVID-19 pandemic in the early 2020s where, following transmission identified among mink, the Danish farmed mink population was exterminated. Uncertainty as to whether fur farming is likely to be banned has affected producers elsewhere, who are less inclined to fund improvements to their management and housing systems if they are uncertain whether they will be permitted to continue to produce fur animals in the future. Fur farmers in Estonia have voiced frustration at the frequent changes to the fur farming regulations. Meeting demands for new regulations regarding the well-being of animals in their care and also environmental impacts of fur farming, in particular the risks of escapes of animals into the wild environment, causes problems in the future planning of their fur farming operations. An amendment was passed to the Animal Protection Act (Riigiteataja, 2021) that bans fur farming in Estonia, “It is prohibited to keep, breed and propagate animals solely or mainly for the purpose of production of fur” and this will come into force in 2026. Other European countries that have banned fur farming include the United Kingdom, Austria, North Macedonia, Slovenia, Croatia, Luxembourg, Serbia, the Czech Republic and the Netherlands, Belgium, France, Norway, Slovakia, and Bosnia and Herzegovina. While these countries generally had small, if any, numbers of fur producers, it is likely that other countries will follow. The ethics of keeping animals for fur has been reviewed (e.g., Arney and Piirsalu, 2017) and there is strong public support for change. Public understanding and ability to articulate robustly their reasoning for their abhorrence for fur farming may be limited but their feeling that it is wrong is potent and influences policy makers and legislators. And this is not surprising. Wittgenstein tells us, as described and clarified by Rée (2019), that there are some things, such as feelings, love, ideas of rights, for which we do not have the language to adequately define or describe. It is difficult then to argue on the grounds of evidence and philosophical debate against a public that wishes to ban fur farming. For fur farm producers, unlike the farmers of other animals, there is not really the traction in improving welfare for the general public, or indeed policy makers. Improvements to the well-being of pigs by adding straw to pens or adding puzzle toys to laboratory rat cages or describing how distress might be lessened by removing calves from dams early have a point and can help justify their use. But providing access for mink to water to improve their welfare and quality of life does not really help ameliorate the public perception of mink farms. And this is an important distinction. For fur farming, welfare concerns do not really come into it. The general public just think that it is wrong, and that is that. Nevertheless, fur farming continues to be practised and the welfare of these animals remains of concern and
Farming nondomesticated land animals

should be ameliorated such that the quality of their lives is as good as can be achieved given the constraints of their farming conditions.

Commonly kept animals for fur include the chinchilla (Chinchilla lanigera) Figure 9.1, the red fox (Vulpes vulpes) Figure 9.2, the silver fox (Vulpes vulpes) Figure 9.3, the blue fox (Vulpes lagopus), the mink (Neogale vison) Figure 9.4, the raccoon dog/Finnraccoon (Nyctereutes procyonoides) Figure 9.5, and the rabbit (Oryctolagus cuniculus).

The evaluation of the welfare of fur-bearing animals has been examined, tested, and codified into protocols for mink (Møller et al., 2015), foxes (Ahola et al., 2015), and Finnraccoons (Koistinen et al., 2014). These are based on the Welfare Quality protocols for cattle (Welfare Quality® 2009a), pigs (Welfare Quality® 2009b), and poultry (Welfare Quality® 2009c), with four welfare fundamentals: good housing, good feeding, good health, and appropriate behaviour, all of which feed into the fifth fundamental: positive affective (mental) states. These include rel-

Figure 9.1  Chinchilla, photo Peep Piirsalu.

Figure 9.2  Red fox, photo Peep Piirsalu.
evant content and animal-based measures for each of the species (Mononen et al., 2012). These protocols also include an assessment of stockmanship quality by estimating the quality of the human–animal relationship through a feeding test, temperament test and extent of handling and transportation of the animals. The fur farming industry appears to have adopted these as appropriate and they are recommended for use by fur producers’ organisations (Fur Europe, Sagafurs, Furmark). A complication for these assessment protocols in fur production systems is the greater seasonality of the husbandry and management of these species compared to, say, cattle pigs and poultry. The annual production cycle is much less flexible in regards to mating times, whelping times, and slaughter ages. Different welfare outcomes might be expected from the animals at the various stages in the cycle, necessitating repeated visits during the year by assessors.

There are a range of concerns regarding the quality of the life experienced by farmed fur-bearing animals, some of which can be eased by management practices, but some of which appear to be inevitable consequences to these undomesticated animal species of their being
Farming nondomesticated land animals

caged, handled, and restricted in access to resources that are of importance to them. While these animals may thrive as far as health and productivity are concerned, they may nevertheless suffer from an inability in caged systems, and caged conditions are what prevail, to carry out the range of behaviours that are important to them. Few mink farms offer access to water, even though this is important to them (Mason et al., 2001). In Mason et al.'s study, mink were prepared to work (push open weighted gates) harder to get access to water than toys or a raised platform (both of which are known to be desirable resources for them). Deprivation of access to water raised urinary cortisol as much as feed deprivation. While it is not clear whether these deprived mink were water-experienced or not, this does show that the motivation and frustration of denial to perform such behaviour is important to these animals. This does not mean that the provision of other environmental enrichment is unimportant; boredom is a concern and can be relieved by the addition of such enrichments as rubber toys, shelves, and troughs of running water in mink (Meagher and Mason, 2012). Silver foxes too suffer from stress, as evidenced by behavioural and cortisol indicators, but it can, as with other animals (Neely et al., 2018), be reduced by handling in early life (Pedersen and Jeppesen, 1990). Although caging of fur-bearing animals is a problem for foxes, mink, and raccoon dogs, it may be less important for these solitary species, which in the wild spend time resting in confined spaces, than for rabbits, which are social animals. Housing rabbits in small cages restricts their spectrum of behaviours (Dixon et al., 2010), such as burrowing, foraging, and the full range of social interactions with conspecifics.

Stereotypical behaviour, an indicator of poor environmental conditions, has been observed in farmed mink (pacing, somersaults, circular movements of the head (Hansen et al., 2010)), blue foxes (pacing, tail-chasing, cage-biting, tail biting (Korhonen et al., 2001)), chinchillas (fur-chewing bar chewing, cage scratching, and backflipping (Franchi et al., 2016)), raccoon dogs (pacing, scratching at cage, head twirling, and biting or licking the cage (Koistinen et al., 2018)) and rabbits (biting bars and smelling bars (Mugnai et al., 2009) and repetitive hair-chewing, bar-chewing, head-swaying, and pawing (Gunn and Morton, 1995)). In rabbits, the motivation for and expression of these stereotypical behaviours may be reduced by group housing, although this can lead to agonistic behaviour (Mugnai et al., 2009), so their welfare might be jeopardised in group housing too. Genetic selection (Hansen et al., 2010) for lower rates of stereotypical expression may not actually improve the well-being of the mink, as selected animals show signs
of increased fear (Svendsen et al., 2007). Fear, particularly fear of the approach of humans, is also a distressing state for any animal that is in regular contact with humans. Mink do demonstrate fear of humans, and less fear of humans is one of the attributes that is thought necessary for the successful domestication of a species. This fear is a predictable consequence of their recent partial domestication, although this can be moderated by genetic selection (Malmkvist and Hansen, 2002). This fear response then seems to be heritable, and therefore may be manageable by producers. Encouragingly, the selection for reduced fear response has no linked negative outcomes on their production values (Thirstrup et al., 2019).

**Deer**

Species of deer that are farmed are principally Reindeer (*Rangifer tarandus*), and Red Deer (*Cervus elaphus*), but also Fallow Deer (*Dama dama*) and Musk Deer (*Moschus moschiferus* and several subspecies). The FAO (de Vos, 1982) also lists the Wapiti (*Cervus canadensis*), Sika (*Cervus nippon*), and Rusa Deer (*Cervus timorensis*) among farmed deer globally. Rearing deer can be an attractive option for farmers as their meat is of high value, regarded as healthy compared to other more traditional meats, and hence the numbers of deer and deer farms is increasing (Proskina and Cerina, 2021). These animals are all scarcely domesticated, if at all, and therefore if they are to be farmed this should be in extensive systems with as little contact with humans as possible.

**Red deer and fallow deer**

Red Deer and Fallow Deer are farmed extensively and their marketable products are principally venison meat and the soft velvet covering their antlers (for traditional Chinese medicine and other alternative medical offerings). They are mostly kept at pasture but may be housed during the winter (Bartoš and Šiler, 1993), although this is not thought necessary for adults and can lead to aggression and injuries (Pollard and Littlejohn, 1998). This can also be a problem at pasture if stocking densities are too high, which is considered to be over 8 red deer or 16 fallow deer per hectare (see review by Mattiello, 2009). Welfare concerns in deer include predation, which can cause mortality of up to 50% in Italy (Mattiello, 1994), poor fencing entangling individuals, lack of shelter, no access to a wallowing area, handling, restraining, loading, transport, and slaughter. Handling procedures for transport (Waas et al., 1999b; Bornett-Gauci et al., 2006;) and slaughter are particularly distressful to deer, which are only partially domesticated, and are usually infrequently handled. Although a review by Weeks (2000) suggests that deer’s experience of transport might not be expressly different from that in other ruminants, she does recognise that deer are more flighty and should be provided with specialist handling and transport facilities. For this reason it is thought that on-farm slaughter, through shooting by a marksman, is preferable to slaughter at an abattoir or on-farm in a mobile slaughterhouse (Bornett-Gauci et al., 2006).

The feeding of deer is different from cattle and sheep. They have more highly variable seasonal intakes, they are intermediate feeders (they both browse and graze), and will preferentially select browse if it is available, and pastures suitable for cattle and sheep are not necessarily suitable for deer (Mulley, 2003). This difference in feeding behaviour should be recognised by deer farming management systems to maximise welfare and productivity, such as by providing browse and adjusting stocking rates at pasture and possibly offering concentrates in different seasons.

Mattiello (2009) suggests some criteria for the evaluation of deer welfare on farms, and similarly criteria have been described for wild deer (Green, 2016). The evaluation of pelt-biting, as a record of incidences of agonistic behaviour, has been proposed as a stand-alone indicator of poor welfare (Pérez-Barbería et al., 2021). Typical stereotypic behaviours of red deer include
Farming nondomesticated land animals

wall pacing and vertical/horizontal head movements at the walls of pens (Pollard and Littlejohn, 1996). However, no established protocols have been devised and accepted for the evaluation of the welfare of on-farm deer.

A particular mutilation of deer is the removal of antlers while they are still growing, with severance of nerves and blood vessels, in order to remove their soft velvet covering. This is a product that is valued in the Far East and is peculiar only to those deer farmers, including in New Zealand and North America, that supply these markets (Putman, 1988; Conaglen et al., 2003). Among other claims, deer velvet is said to improve sexual function in human males, a claim which has been tested and for which there is no evidence (Conaglen et al., 2003), and human sport/exercise performance, which has also been tested and for which there is no evidence (Sleivert et al., 2003). To harvest the antler velvet the antlers are surgically removed; best practice includes anaesthesia, for which a range of techniques and drugs are proposed (Johnson et al., 2005), and removal of the antlers by a veterinarian. Where this is not followed and regulated, the suffering experienced by the stags is extremely high. There is concern about the duration of the analgesic effect of administered drugs, the pain experienced by the deer post-operatively, and the distress of the stags when they are isolated, confined, and handled for this procedure (Wilson and Stafford, 2002). Additionally, in regard to human well-being, there is also the concern of drug and drug metabolite residues entering the velvet (Walsh and Wilson, 2002) and subsequently into the humans that consume it.

**Reindeer**

Reindeer are reared in extensive conditions. They mate without human assistance or selection of mates by herders, except inasmuch as animals planned for slaughter are removed from the breeding herd. They calve on their own, without human intervention; forage for their own feed; are not routinely given supplementary feed except in the winter, when they may be provided with hay and concentrates at pasture; are not housed; and only have close human contact in the summer, when they are collected together for the ear-marking of unmarked animals. The handling and coercion involved in this is known to be particularly stressful for reindeer (Rehbinder et al., 1982). They are then let free again to wander and forage as they please until the autumn when they are again collected together (Figure 9.6) for selection of animals for slaughter, parasitic treatment, and vaccination. Some herders then release them back into the forest for the winter, others keep them in in-by pens. In the latter case they are given hay and sometimes small amounts of concentrates. They are then released into the wild in early spring. Around 100,000 reindeer are slaughtered each year in Finland (Askoja SJ, personal communication). Slaughter may be on-farm, but in the EU this must be done, for reasons of hygiene (Rehbinder and Hau, 2006), in a slaughterhouse. Animals for slaughter are inspected by a veterinarian within 24 hours prior to slaughter. The transport of reindeer to slaughterhouses is stressful and leads to impaired welfare and carcase quality, even if the transportation distance is short (Laaksonen et al., 2017).

The welfare of these animals in the wild is not necessarily good, since they can suffer from predation, exposure to the weather, endo- and ecto-parasites, particularly the warble fly (Waller, 2002), and the annoyance of biting and blood-sucking flies in the summer (Kynkäänniemi et al., 2014). Foraging can be difficult, especially in areas where stocking densities are high and availability of feed is poor, which has become more of a problem recently and has led to the necessity for the provision of feed in the winter, which was not part of traditional reindeer herding practice. If, as expected, the climate warms and becomes wetter it might be expected that snow cover will be deeper than previously, making foraging in the winter months even more difficult.

The evaluation of the welfare of reindeer by estimating cortisol metabolites in faeces has been proposed (Özkan et al., 2019), but otherwise no protocols for their welfare are available.
Musk deer

The last of the deer to be considered here, musk deer, are not true deer, being more closely related to bovines than to the cervidae. Their principal product is musk, which is secreted by the males from their scent gland. Their production levels are very small and farmed production is localised in the Far East (Parry-Jones and Wu, 2001). These authors identified problems of high disease and high mortality in these farmed musk deer, but it has been proposed that both of these indicators can be reduced with larger enclosures (Liu et al., 2010). The welfare problems of farmed musk deer include the binding of hind legs to prevent jumping and the clipping of tusks, to prevent injury to conspecifics and stockpeople, see review by He et al. (2014). Another welfare problem is that musk deer are naturally solitary animals in the wild, and this can be incompatible with group living. Other welfare problems identified by He et al. (2014) may be better managed with more understanding, such as inappropriate nutrition (they are often treated as grazers rather than the browsers that they are, with unsuitable feed offered to them, perhaps including concentrates), the lack of shelter from the weather on many farms and little genetic diversity in the farmed population, consequent to genetic drift from the small initial population collected from the wild, possibly leading to high rates of negative traits associated with dystocia (difficulties during birth or its prolongation), infant mortality, and morbidity.

Rabbits

Rabbit farming systems for their meat as the primary product can be attractive for farmers as they have low start-up costs, the animals are precocious and prolific, with a shorter gestation period than other livestock species, and have low husbandry and feed costs. In Europe farming rabbits can often be an adjunct to the production of the main livestock animal of a farm. In which cases it may be that they receive less attention and resources.

The biggest welfare problems for farmed rabbits are due to their partial domestication and incomplete adaptation to confinement in farm conditions (see review by Verga et al., 2009). Breeding animals are usually kept singly, while finishing animals may be kept in small groups. For a social
animal this might be assumed to be stressful, and behavioural indicators suggest this is so (Whary et al., 1993), although there can also be high rates of aggression among does in groups (Ruis, 2006). A solution to this, of providing mirrors in single-housing laboratory rabbit cages, has been proposed (Edgar and Seaman, 2010), although the rabbits seem to respond to a mirror not as if to a conspecific it may nevertheless be an environmental enrichment similar to a soft toy (Jones and Phillips, 2005). Other problems discussed by Verga et al. (2009) include high stocking densities, too-early weaning, insufficient environmental enrichments, space allowance, transport, lairage and slaughter, and poor or lack of early handling by their keepers. Some of these, such as stocking rates, will have an economic cost to improve (Verspecht et al., 2011), while others could be readily improved through improved husbandry techniques. Even the provision of a simple environmental enrichment, such as a hanging wooden stick, reduced observed stereotypies in rabbits while also having a positive effect on production performance (Luzzi et al., 2003), possibly through the effect gnawing a hard material on reducing incisor overgrowth. Cage sizes are of concern, if they are too small the rabbits will be unable to hop and interact as they would be motivated to do. While on the face of it, it might seem better for the welfare of rabbits to be housed in open-topped pens rather than wire-surround cages, and this is supported by behavioural observations by Podberscek et al. (1991), Rauterberg et al. (2021) found that welfare indicators (lower fertility and more injuries) and health indicators were actually worse in the former. Heat stress may be a problem for rabbits (Liste et al., 2006). The transport of rabbits to slaughter is known to be stressful (Mazzone et al., 2010), and when they arrive at the slaughterhouse, waiting times at lairage longer than six hours raise blood stress indicators (Liste et al., 2009) and so should be kept as brief as possible. Protocols for the evaluation of rabbit welfare have not to date been used in practice on any scale. Verga et al. (2009) suggest some behavioural indicators that could inform such an evaluation, and stereotypies shown by caged rabbits include repetitive hair-chewing, bar-chewing, head-swaying and pawing (Gunn and Morton, 1995), and somersaulting. A tail-bitting score has also been proposed (Bill et al., 2019). An evaluation system for rabbit welfare has been suggested and tested by Cerioli et al. (2008) based on three criteria of: management and husbandry, prophylaxis, treatment, and housing, and a welfare evaluation system based on Welfare Quality® (2009a–c) protocols, with the guiding principles of good housing, good feeding, good health, and appropriate behaviour, has also been presented but their use has not to date been widely practised.

Conclusions

A wide range of species and management types have been considered, and there are consequently many different problems that these species face. A common problem is that these animals are undomesticated, or partially domesticated at best, so are likely to be ill-suited to captivity and handling. In addition, there is comparatively little welfare research work that has been undertaken with these species which are less common than the usual domestic species farmed for food. There are few established protocols for the evaluation of the welfare of these animals tested on these animals in farmed conditions compared to more commonly farmed livestock. These should be developed, tested, and provided to farmers and local assessors in a clear, practical way to encourage the best husbandry systems for these animals, and reliably assess their on-farm well-being if we are to continue their use for our purposes.

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References


Farming nondomesticated land animals


113


