The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK
www.ufaw.org.uk

Animal Welfare 2012, 21: 363-371
ISSN 0962-7286
doi: 10.7120/09627286.21.3.363

The development of on-farm welfare assessment protocols for foxes and mink: the WelFur project

J Mononen*†, SH Møller‡, SW Hansen‡, AL Hovland§, T Koistinen†, L Lidfors#, J Malmkvist‡, CM Vinke¶ and L Ahola†

† Department of Biology, University of Eastern Finland, PO Box 1627, FI-70211 Kuopio, Finland
‡ Department of Animal Science, Aarhus University, PO Box 50, DK-8830 Tjele, Denmark
§ Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, PO Box 5003, NO-1432 Aas, Norway
# Department of Animal Environment and Health, Swedish University of Agricultural Sciences, PO Box 234, SE-532 23 Skara, Sweden
¶ Department of Animals in Science and Society, Faculty of Veterinary Medicine, PO Box 80166, 3508 TD Utrecht, The Netherlands
* Contact for correspondence and requests for reprints: jaakko.mononen@uef.fi

Abstract

*The WelFur project aims at the development of on-farm welfare assessment protocols for farmed foxes (the blue fox [*Vulpes lagopus*], the silver fox [*Vulpes vulpes*]) and mink (*Neovison vison*). The WelFur protocols are based on Welfare Quality® (WQ) principles and criteria. Here, we describe the WelFur protocols after two years of developmental work. Reviews for each of the 12 WQ welfare criteria were written for foxes and mink to identify the welfare measures that have been used in scientific studies. The reviews formed the basis for potential measures to be included in the WelFur protocols. All measures were evaluated for their validity, reliability and feasibility. At present, we have identified 15 fox and 9 mink animal-based (or outcome-based) welfare measures, and 11 and 13 input-based (resource-based or management-based) measures. For both foxes and mink, each of the four WQ principles is judged by at least one criterion, and seven out of the 12 criteria include animal-based measures. The protocols will be piloted in 2012. Using the WQ project and protocols as a model has been a fruitful approach in developing the WelFur protocols. The effects of the WelFur protocols will provide benchmarks from which the welfare of animals on European fur farms can be assessed.*

Keywords: *animal-based welfare measures, animal welfare, input-based welfare measures, fox, fur farming, mink*

Introduction

Foxes (the blue fox [*Vulpes lagopus*], the silver fox [*Vulpes vulpes*]) and mink (*Neovison vison*) are the most important farmed fur animals in the world. In 2010, the production was 3.7 million fox pelts and 46.5 million mink pelts, and more than fifty percent of fox and mink pelts were produced in Europe. In 2010, fox pelts were produced in two, and mink pelts in 15, countries on a total of 3,500 farms in the member countries of the European Fur Breeders' Association (EFBA), the umbrella organisation of the European national fur breeders' associations. In 2009, EFBA decided to develop on-farm welfare assessment protocols for foxes and mink ('WelFur') for certification and advisory purposes. In this paper, we describe the development of these WelFur protocols and the current state of the art after two years' work. In line with the extent of fur farming in various European countries, fur animal researchers from Finland, Denmark, Norway, Sweden and The Netherlands have been responsible for the scientific development of these WelFur protocols.

The fox and mink WelFur protocols are based on four welfare principles and 12 welfare criteria (see Table 1) developed in Welfare Quality® (WQ) and used in protocols for cattle, pigs and poultry (Welfare Quality® 2009a,b,c, respectively). An important aspect of using WQ as a model for WelFur is the three-step approach of WQ (Figure 1): i) welfare measures are integrated into criteria scores (preliminary results reported for WelFur: Gaborit *et al* 2011); ii) criteria scores are integrated into scores for the four principles; and iii) overall welfare assessment of a farm is based on a combination of the four principle scores (Welfare Quality® 2009a; pp 23-27). The importance of the various criteria within each principle was compiled in WQ by animal welfare experts. The evaluation is independent of animal species (Veissier *et al* 2009) and, therefore, WelFur uses the WQ 'criteria-to-principle' formula, including the weighting of various criteria. The principle scores in WelFur were then combined into an overall welfare classification for a farm in the same way as in WQ.

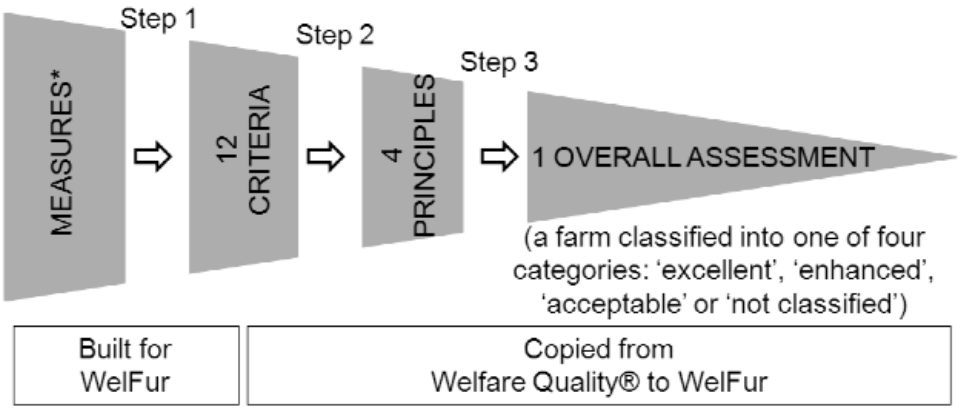
Table 1 WelFur welfare measures for farmed foxes and mink, and their classification to animal-based (AN) and input-based (IN) measures.

4 Principles and 12 criteria	Foxes			Mink		
	Welfare measures	**V**	**R**	**Welfare measures**	**V**	**R**
I Good feeding						
1 Absence of prolonged hunger	Body condition score (AN)	2	2	Body condition score (AN)	2–3	2–3
2 Absence of thirst	Continuous water availability (IN)	3	3	Continuous water availability (IN)	3	3
	Functioning and cleanliness of the water points (IN)	3	3	Functioning and cleanliness of the water points (IN)	3	3
II Good housing						
3 Comfort around resting	Availability of a platform (IN)	2	3	Availability of a nest box (IN)	3	3
				Resting quality of the nest box (IN)	3	2
	Cleanliness of the fur (AN)	2	2			
4 Thermal comfort	Protections from exceptional weather conditions (IN)	2	2	Protections from exceptional weather conditions (IN)	2–3	2
				Bedding material and insulation of nest box (IN)	1–3	2
5 Ease of movement	Space available for moving (area and height) (IN)	2	3	Space available for moving (area and height) (IN)	1–2	3
III Good health						
6 Absence of injuries	Skin lesions or other observed injuries or lesions to the body (AN)	3	3	Skin lesions or other observed injuries or lesions to the body (AN)	2–3	
	Difficulties in moving (AN)	3	3			
7 Absence of disease	Mortality (AN)	3	2	Mortality (AN)	2–3	2
	Bent feet (AN)	2	2	Lameness and impaired movement (AN)	2–3	2–3
	Ocular inflammation (AN)	3	3			
	Impaired mouth and teeth health (AN)	3	3			
	Diarrhoea (AN)	2	2	Diarrhoea/sticky kits (AN)	2–3	2–3
	Urinary tract infections (AN)	3	2			
	Obviously sick animal (AN)	3	3	Obviously sick animal (AN)	2–3	2–3
8 Absence of pain induced by management procedures	Use and type of neck tongs (IN)	2	3	Killing methods for single animals (IN)	2–3	3
	Killing methods (IN)	3	3	Killing methods at pelting (IN)	2–3	3
IV Appropriate behaviour						
9 Expression of social behaviours	Social housing (IN)	3	3	Social housing (IN)	2–3	3
				Age at weaning and weaning procedures (IN)	2–3	3
10 Expression of other behaviours	Opportunity to use enrichment (IN)	3	3	Opportunity to use enrichment (IN)	1–3	3
	Opportunity to observe surrounding (IN)	3	3			
	Stereotypic behaviour (AN)	3	3	Stereotypic behaviour (AN)	2–3	3
	Fur chewing (AN)	2	3	Fur chewing (AN)	2	2–3
11 Good human-animal relationship	Feeding test (AN)	3	3	Temperament test (see below) includes also criterion 11		
12 Positive emotional state	Temperament test (stick test) (AN)	1	2	Temperament test (stick test) (AN)	2–3	2–3
	Transportation of live animals (IN)	3	3	Handling and transportation of live animals (IN)	2	2

V = validity scoring and R = reliability scoring from low (1) to high (3): a range indicates difference between the three production periods or animal groups (eg juveniles vs adults) within a period.

https://doi.org/10.7120/09627286.21.3.363 Published online by Cambridge University Press

Figure 1



The utilisation of the three step Welfare Quality® approach (Veissier *et al* 2009) in WelFur. * There are 26 and 22 welfare measures for foxes and mink, respectively (see Table 1).

Although some welfare measures may be suitable for many species, the sets of measures as a whole, and the transformation of measurements to criteria scores, is species-specific (cf Welfare Quality® 2009a,b,c). The first task for WelFur was to find valid, reliable and feasible welfare measures for foxes and mink. This paper focuses primarily on presenting the welfare measures chosen, but also discusses, briefly, the process behind the choices and their justification. In line with WQ, one major aim in WelFur has been to include in the protocols as many animal-based (or welfare outcome-based) measures as possible, as opposed to management-based and resource-based (or input-based or design-based) measures. If it is not practically possible to use an animal-based measure (eg the measure is not feasible on a farm), then it may be possible to use a feasible input-based measure that has been shown to correlate well with the animal-based measure (eg Welfare Quality® 2009a; pp 21–22).

The annual production cycle on fur farms is first outlined, and any effects it may have on the implementation of WelFur is described.

Annual production cycle on fur farms: implications for WelFur protocols

Foxes and mink are monoestrous animals, which leads to a relatively fixed annual cycle with three distinguishable production periods (European Commission 2001). Typically, all production periods take place on each farm, and simultaneously on all farms (Møller *et al* 2003). From pelting in late autumn or early winter to whelping in the spring (Period 1) there are only breeding animals on the farms: usually one male for five females if natural mating is used (some fox farms and all mink farms), or one male for 15–20 females if artificial insemination (AI) is used (most fox farms). Breeding animals are housed singly. The mating/AI period spans from February to late March in silver foxes, from March to late April in blue foxes, and from late February to late March in mink. Gestation lasts 51–53 days in foxes and 40–70 days in mink. Period 2 is from whelping to weaning, during which the fox vixens and mink dams nurse their offspring. Cubs and kits start to eat solid food at the age of about four weeks, and are separated from their mother, ie weaned, at the age of 6–10 weeks in June-July. The growing period (Period 3) lasts from weaning to pelting in late October-December.

The optimal time windows for on-farm welfare assessment visits within each period are narrow. In Period 1, the assessment should be carried out well after pelting time but before mating, ie only after all breeding animals, including the primiparous animals, have been moved to the cages where they wait for mating or AI. In Period 2, the aim is to assess the welfare of both the vixens/dams and the cubs/kits, and the optimal time window is after the offspring leave the nest, at the age of three to four weeks, until they are weaned. In Period 3, the welfare of both adult breeding animals and juveniles should be assessed. In this period, the optimal time for welfare assessment depends more on the development of the juveniles, since potential problems indicated by most animal-based measures are more overt in the later phase of Period 3.

Contrary to the farm animal productions assessed by WQ, all production periods take place on one and the same fur farm. A complete welfare assessment of a farm will require three visits but it will cover the whole lifespan of all animals, including killing. The narrow time windows for the assessment visits make the implementation of WelFur challenging in practice (Møller & Hansen 2011).

The development of the WelFur protocols

Reviews (to be published later) of each of the 12 WQ welfare criteria were written to identify all potential welfare measures that have been suggested or used for farmed foxes and mink. The reviews formed the basis for the evaluation of the validity, reliability and feasibility of the potential measures. The suggestions and evaluations were discussed,

scrutinised and modified during five meetings by the WelFur project group which included three external animal welfare experts. The validity and reliability of the measures were evaluated on a three-point scale: 1 = low certainty; 2 = medium certainty; and 3 = high certainty (European Food Safety Authority 2008; p 64). The majority of the measures used in scientific studies were regarded as not feasible based on a three-point subjective scoring by experts: 1 = 'not possible on commercial farms'; 2 = 'possible but very laborious'; and 3 = 'sufficiently feasible'. Only measures rated as 'sufficiently feasible' were included in the protocols. This therefore excluded some forms of measures such as blood and urine sampling.

Preliminary WelFur protocols which included a list of measures and instructions for carrying out the measurements (cf Welfare Quality® 2009a) were piloted on farm visits in 2010–2011. The results and experiences from the visits were used to modify and refine the protocols.

Welfare measures in the WelFur protocols

The welfare measures in the fox and mink WelFur protocols are listed in Table 1 with the information on the validity and reliability of the measures on the three-point scale.

Good feeding

Body condition score (BCS) was used as an animal-based measure for assessing the criterion 'Absence of prolonged hunger' for both foxes and mink. In the autumn (Period 3), animals to be pelted are fed *ad libitum* and, consequently, tend to be obese rather than thin, which may be a problem in farmed blue foxes (Kempe *et al* 2009), but not to the same extent in silver foxes (Hovland & Bakken 2010) or mink (Møller 2000). In order to bring obese animals into condition for mating, feeding is often restricted on farms in the winter (Period 1). Before mating (Period 1) and in late nursing (Period 2) the low BCS of animals is therefore a good indicator of previous hunger experienced by the animals (blue foxes: Kempe *et al* 2009; mink: Møller 1992; Damgaard *et al* 2004). BCS is a reasonably reliable measure in mink (Hansen *et al* 2009) and there is no reason to doubt that this would not also be the case for foxes. As with all measures, the assessors have to be trained (cf Kempe *et al* 2009), especially when estimating low body condition scores. As body condition can be estimated reasonably accurately without catching and handling the animals, BCS is a more feasible measure than, for example, weighing and taking body length measures to calculate body mass index.

Continuous water availability, and the functioning and cleanliness of the water points, were considered reliable input measures for 'Absence of prolonged thirst', but reflect the difficulty in finding a feasible animal-based measure for this criterion (cf Welfare Quality® 2009a,b,c). Signs of prolonged thirst are evident if the situation is very bad, but suffering will have occurred well before these signs appear (cf Veissier *et al* 2009; p 23). Even though most foxes and mink are fed with fresh feed containing 65–70% water, it is evident that they also need continuous access to drinking water. If non-frost-proof drinkers are used in the winter and foxes are given water only once a day, the concentrations of urea, sodium and osmolality in the urine increase compared with foxes supplied with frost-proof drinkers (Moe *et al* 2000). Adult mink males ingested approximately 80 ml per day in 25 drinking bouts in February-March (Møller 1991), which very probably indicates the need for continuous access to drinking water.

During the summer, water points with cups may be dirty and have algal growth which may affect the quality and, therefore, the true availability of water. However, there are no studies on the effects of the dirty water cups on water intake in foxes or mink. As animals should be given the opportunity to fulfil their basic need for water, it was agreed that the cleanliness of the water points should be included in the 'Absence of prolonged thirst' criterion. This is in line with the European Convention (1999) that recommends that "all animals shall have... continuous access to an *ad libitum* supply of water of suitable quality".

Good housing

Access to a resting platform is obligatory in the two fox-producing EFBA countries, Finland and Norway. Availability of a platform is also included in the WelFur fox protocols as an input measure for 'Comfort around resting'. Foxes show a strong preference for using platforms (Mononen 1996), although some studies have failed to show the effects of platforms on other welfare measures (eg stereotypies in silver foxes: Kasanen *et al* 2001; fear in blue foxes: Korhonen & Niemelä 1996; adrenal function in blue and silver foxes: Mononen *et al* 2001 and Kasanen *et al* 1999, respectively). The differences between studies may be because only a narrow range of measures were used in some studies and so did not reveal any differences.

In Europe, mink have year-round nest boxes (European Commission 2001), and they spend most of their resting time in the boxes (Hansen *et al* 1994). The availability (Hansen *et al* 1994) and quality (Møller 1990) of a nest box are of great importance to mink, and are thus valuable and appropriate input welfare measures.

Typically, farmed foxes do not have year-round nest boxes, but nest boxes are provided only for the breeding vixens from late gestation to the time when the cubs are at four to five weeks old (European Commission 2001). In theory, nest boxes might provide opportunities for undisturbed rest at least for timid animals, but this has not been studied. Altogether, the welfare effects of year-round nest boxes on foxes' welfare are contradictory (Mononen 1996), although they have been recommended for adult silver foxes (European Commission 2001; see also Jeppesen & Pedersen 1991). Furthermore, many blue foxes soil any solid surfaces in their cages (with urine and faeces), and blue foxes with year-round nest boxes with solid floors probably have poorer resting comfort (and also have poorer fur quality) than animals without the year-round nest boxes (Korhonen *et al* 2006). There are no scientific studies in foxes or mink on the effects of dirty fur on animals' welfare. Notwithstanding that, cleanliness of the fur is included in the WelFur protocols as an animal-based measure of resting comfort for

https://doi.org/10.7120/09627286.21.3.363 Published online by Cambridge University Press

foxes, as it may be correlated to cleanliness of the cages, which in turn affects the animals' opportunity to choose where to rest. The implication of including this measure is to encourage the farmers to keep the cages clean in Periods 1 and 2, and not only in Period 3 which is generally accepted as the crucial period for obtaining clean pelts. Due to the low incidence of dirty mink, the validity of fur cleanliness as a mink welfare indicator is under evaluation.

The availability of a platform for foxes, as well as the availability of a nest box and its resting quality for mink (Hansen *et al* 1994), can easily and reliably be assessed. Subjective scoring of cleanliness of the fur of living animals has been used in scientific studies (eg blue foxes: Korhonen *et al* 2006), but its reliability has not been evaluated. However, as in the case of BCS, reliability should not be a problem after proper training of the assessors.

The temperature in non-insulated barns (with walls) or sheds (without walls) parallels ambient temperature quite closely (Kivinen & Korhonen 2006). Farmed fur animals are well adapted to the annual temperature fluctuations, and in general, foxes can cope well with low temperatures because of their thick fur and subcutaneous fat (Korhonen *et al* 1983). In mink, this is achieved with the aid of a nest box with bedding. In hot weather, the animals rely on behavioural thermoregulation: they move to the shade and/or lie stretched-out. However, when considering all European countries with fur farming, farmed foxes and mink may be exposed to ambient temperatures ranging from about −40°C in winter to over 30°C in summer, and such extreme temperatures may at times compromise an animal's welfare. Overt shivering and panting could be regarded as valid animal-based signs of jeopardised welfare, but these are totally dependent on the ambient temperature during the visit, and have low feasibility. Accordingly, only input-based measures for the 'Thermal comfort' criterion were used. The measures were chosen in a way that they help farmers identify alternative ways for maximising thermal comfort of their animals in extreme weather conditions: eg to reduce the chilling effect of wind, to increase ventilation or to cool the houses with water sprinklers or misters during hot weather, or to provide mink nests with good insulation.

Space available for animals to move, including area and height of the cage, was chosen as an input measure for the 'Ease of movement' criterion for both foxes and mink. In foxes, increasing the cage area above the level of the European recommendations either had no effect on locomotor stereotypies and adrenal function (blue foxes: Korhonen *et al* 2001a; silver foxes: Ahola *et al* 2002) or increased the occurrence of stereotypies and cortisol excretion (blue foxes: Korhonen *et al* 2001b). However, the latter results may be due to the smallest cage size in the experiment inhibiting the animals' opportunity for movement and thus the expression of related activities. Therefore, the acceptable limit for available cage area is set at the same level as of the European recommendations. The marked increase in the size (including the body length) of blue foxes during the last few decades (see eg Dahlman 2003) supports the need to comply with these recommendations.

Foxes have a strong preference to stay or rest on elevated places inside their cages (Mononen 1996; Ahola *et al* 2000; Korhonen & Orjala 2010), and the opportunity for vertical movement may also improve the animals' muscle and bone strength (Ahola *et al* 2000). Therefore, to allow foxes access to cage heights above the European recommendations is rewarded in the WelFur fox protocol by giving it a higher score than lower cage heights.

In mink, European recommendations (European Convention 1999) on cage size provide for good welfare. Larger cage sizes do not in themselves improve welfare in terms of decreased frequencies of abnormal behaviours (eg Hansen *et al* 1994, 2007), but may, together with other factors (eg increased complexity), have positive effects on behaviour (Jeppesen *et al* 2000). Therefore, the space and height limits for satisfactory welfare level have been set according to the European recommendations.

Good health

The animal-based welfare measures in 'Absence of injuries' and 'Absence of disease' criteria have good face validity, since most injuries and diseases are very probably related to pain and distress. The overt signs of injuries and disease can be assessed rather reliably (Ahola *et al* 2011) in animals, or in their urine, faeces or other discharges. Thus, the main task in WelFur was to identify the measures that most efficiently reflect animal health and welfare on fur farms.

Skin lesions in foxes and mink can result from bites from cage mates (eg silver foxes: Ahola *et al* 2002; mink: Pedersen *et al* 2004; Hansen & Jeppesen 2008) or, on rare occasions, from bites of neighbouring animals, or from sharp damaged cage structures. In mink and foxes, the prevalence of skin lesions and other injuries is about 1% in the autumn (Sanson 2011) and therefore all injuries to the body (including missing extremities such as part of the ear or tail) have been included in this measure. The percentage of animals that have difficulty in moving around (often related to fast growth and obesity) was categorised as a separate measure in foxes.

Little research has been conducted on fox diseases, and health records collected by the authorities contain little detail. Therefore, diseases and their signs included in the 'Absence of disease' measures were identified from farmers' magazines and by interviewing veterinarians who specialised in fur farming. The condition of 'bent feet' (ie carpal hyperextension leading to abnormal foreleg carpal joint angle) in blue foxes is probably related to rapid growth and obesity (Kempe *et al* 2010). The validity of bent feet as a welfare measure has not been assessed, but it is assumed that this condition may be painful for the animals. Diarrhoea, urinary tract infections (particularly in breeding vixens) and hypertrophic gingiva (in particular in silver foxes) are common health problems in farmed foxes (Kangas 1982), whereas ocular inflammation has emerged in blue foxes relatively recently.

The health of mink during winter and spring (Period 1 and mating and gestation) is usually good: the use of medication is minimal, and mortality very low (Rattenborg *et al* 1999;

Dietz *et al* 2000). During the nursing period (Period 2) mastitis and 'sticky kits' (an astro- or calicivirus infection causing mucoid exudation and diarrhoea, which gives the kits a 'sticky' appearance), is common (Clausen & Dietz 2000). Once the kits start to eat solid food at four weeks of age other types of diarrhoea and enteritis may be seen (Dietz *et al* 2000) (Periods 2 and 3). Diarrhoea is therefore included as a valid, reliable and feasible measure in all three periods. Lameness and impaired movement are rare in mink (Dietz *et al* 2000; Sanson 2011) but easy to observe when a mink is moving and therefore included also in mink protocol.

Other mink diseases may appear in the growth period: eg nursing sickness, mink viral enteritis, distemper and Aleutian Disease. Many farms vaccinate against viral enteritis and distemper, while test and eradication programmes have been developed against the Aleutian Disease. The signs of these or any other diseases are reflected in the measure 'obviously sick animal' which includes health problems not included as part of the other disease measures and applies to both foxes and mink. Furthermore, information on mortality of animals is requested from farmers who in most countries are obliged to keep such records.

The vaccination of foxes and mink, and blood sampling as a means to help eradicate mink Aleutian Disease, were not included in the 'Absence of pain induced by management procedures' criterion, since the ultimate aim of these procedures is to promote animal welfare.

Other potential painful management procedures are primarily related to handling and killing animals using inadequate methods or equipment. Foxes can be caught by hand or with the aid of a neck tong. Both the systematic use of neck tongs, and the use of tongs without a rubber or plastic cover to prevent mouth and teeth injuries to the animals (see Akre *et al* 2008), are penalised in the WelFur fox protocol.

The choice and proper functioning of the killing method or device at pelting is used as a measure for both foxes and mink. Electro-stunning and killing of individual animals has been shown to be a good method for killing foxes (Korhonen *et al* 2009), and the method can be used easily at all times of the year. Mink are most often killed using CO or CO_2 in a big box at pelting when large numbers are killed (Enggaard Hansen *et al* 1991), and often in a small box or tube if a single animal has to be euthanised.

Appropriate behaviour

The single housing of juvenile animals leads to increased frequencies of stereotypic behaviour (silver fox: Ahola *et al* 2002; mink: Jeppesen *et al* 2000), whereas the group housing may lead to problems of aggression in both juveniles (silver fox: Ahola 2001; mink: Pedersen *et al* 2004) and adults (silver fox: Hovland *et al* 2010). Therefore, social housing has been included in the protocol as an input measure for the 'Expression of social behaviours' criterion. It is, however, noteworthy that the welfare effects of group housing can depend on the management and also on genetic differences between populations (eg mink: Berg & Møller 2010). Therefore, post mortem animal-based measures, eg bite marks on the leather side of the skin, would be preferable to input measures. However, as many mink and foxes are pelted outside the farm of origin, this reliable animal-based measure cannot be taken at the farm visit and is, therefore, not feasible.

In mink, the ideal weaning age is around the end of lactation, at about eight weeks. Early weaning is harmful for both the dam and the kits (Houbak & Jeppesen 1988), whereas later weaning jeopardises the welfare of the dam (Pedersen & Jeppesen 2001). In addition to weaning time, the weaning method also affects animals' welfare: the kits should not be left close to their mother (Houbak & Jeppesen 1988). There are no studies on the effects of weaning age or procedure on the welfare of farmed foxes, and thus a similar validated measure is not available for foxes.

When developing the measure 'Opportunity to use enrichment' as an input measure for the criterion 'Expression of other behaviours', the fur animal welfare experts were asked to place the various types of enrichments tried in the numerous scientific experiments (references not presented for brevity) into three categories: extremely beneficial (eb), very beneficial (vb) and moderately beneficial (mb) to the welfare of the animals. The experts' science-based opinion of the effects of various enrichments on animal welfare was then used for developing the scoring for this measure. The final list for foxes is: bone (eb), wooden block (eb), year-round nest box (eb), ball (vb), rope (vb), digging substrate (vb), straw (vb), scratching plate (mb), and some other enrichment (mb). The list for mink is: bedding material/straw (eb), chewable, moveable and renewable objects (eb), a resting platform or a tube attached to the cage wall (eb), moveable objects/toys (vb), water to swim in (mb), other water-based enrichments (mb), and a running wheel or other objects intended for enrichment (mb). In addition, the 'opportunity to observe surroundings' was chosen as a separate input measure in foxes, since they prefer areas in the cage which give the best possible view (eg Mononen *et al* 1998).

Stereotypic behaviour and fur chewing (eg self-mutilation) were chosen as animal-based measures for the 'Expression of other behaviours', since both phenomena are observed in foxes (Ahola *et al* 2002; Korhonen *et al* 2006) and mink (Jeppesen *et al* 2000; Malmkvist & Hansen 2001), and are well known signs of poor animal welfare (but see, eg Mason & Latham 2004 for stereotypic behaviour).

The feeding test is a validated test for measuring the human-animal relationship in foxes (Rekilä 1999). In the test (lasting 30 s), a fox is offered feed to see if it eats when a person stands beside the cage. In mink, the two criteria 'Good human-animal relationship' and 'Positive emotional state' are regrouped into one as a temperament test (see below) can be argued to reflect both (Malmkvist & Hansen 2002).

The response (fearful, explorative, aggressive or uncertain) of an animal to a wooden spatula (mink) or stick (foxes) pushed through the wire mesh wall of the cage is used as a measure of 'Positive emotional state'. It is a validated indicator (Kirkden *et al* 2010) of temperament in mink (Malmkvist & Hansen 2002) reflecting a mink's general

https://doi.org/10.7120/09627286.21.3.363 Published online by Cambridge University Press

emotional state also in social and novel object tests. This temperament test has been used, although not validated, also for foxes (Rekilä 1999) and so is used as a temperament test for foxes as well.

Transportation in foxes, and transportation and handling in mink are included under the 'Positive emotional state' criterion as procedures that cause negative emotional states (in the absence of injury). In addition, Qualitative Behaviour Assessment (eg Welfare Quality® 2009b) is being considered as a potential indicator for measuring the emotional state in foxes.

Within the 'Appropriate behaviour' principle, as within the other principles, the reliability of the input-based measures is high, since in most cases the assessor can check the situation himself/herself. However, in the case of weaning age and how it is done, the assessor has to rely on a farmer's statement (as with transport and handling of live animals). The animal-based measures that include behavioural observations or tests are challenging in terms of finding sample sizes and sampling methods that ensure both reliability and feasibility.

Animal welfare implications

The WelFur protocols are modern on-farm welfare assessment tools for farmed fur animals and we hope to show how the fur industry can implement WelFur for certification, benchmarking and advisory purposes, to help the continuing improvement of animal welfare on European fur farms.

Conclusion

Using the WQ project and protocols as a model has been an extremely productive approach in developing the WelFur on farm-welfare assessment protocols for foxes and mink.

The present WelFur fox and mink protocols include 15 and 9 animal-based measures, and 11 and 13 input-based measures, respectively (Table 1). For both foxes and mink, each of the four WQ principles is judged by at least one criterion, and seven out of the 12 criteria include animal-based measures. The percentages of animal-based measures, 58% for the fox and 41% for the mink, are slightly lower than in most of the WQ protocols (Welfare Quality® 2009a,b,c). However, the protocols are sufficient for testing the implementation of WelFur. Our experience from the pilot studies that started in 2011, will lead to refining the measures and improving the protocols as a whole.

Acknowledgements

The WelFur protocols would not be at the stage they are now without kind help from the Welfare Quality® experts (Professor Harry Blokhuis, Dr Isabelle Veissier, Dr Raphaelle Botreau and Agricultural engineer, Marion Gaborit), and our two other external reviewers (Professor Georgia Mason and Dr David Morton). We are also grateful to the numerous fur animal experts who have helped us in our work: scientists, veterinarians, advisors, clerical workers from the national fur farmers' associations and fur farmers. EFBA is acknowledged for funding and co-ordination of the WelFur project.

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