CODE OF PRACTICE FOR THE CARE & HANDLING OF RANCHED FOX: REVIEW OF SCIENTIFIC RESEARCH ON PRIORITY ISSUES

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This document is the final Report on Priority Welfare Issues for Silver Foxes. This report was agreed on by the Scientists' Committee on April 13, 2012, and any further changes will entail only minor formatting**.**

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Excerpt from Scientists' Committee Terms of Reference

Background

It is widely accepted that animal welfare codes, guidelines, standards or legislation should take advantage of the best available knowledge. This knowledge is often generated from the scientific literature, hence the term "science-based".

In re-establishing a Code of Practice development process, NFACC recognized the need for a more formal means of integrating scientific input into the Code of Practice process. A Scientists' Committee review of priority animal welfare issues for the species being addressed will provide valuable information to the Code Development Committee in developing or revising a Code of Practice. As the Scientists' Committee report is publicly available, the transparency and credibility of the Code process and the recommendations within are enhanced.

For each Code of Practice being developed or revised, NFACC will identify a Scientists' Committee. This committee will consist of 4-6 scientists familiar with research on the care and management of the animals under consideration. NFACC will request one or two nominations from each of 1) Canadian Veterinary Medical Association, 2) Canadian Society of Animal Science, and 3) Canadian Chapter of the International Society for Applied Ethology.

Purpose & Goals

The Scientists' Committee will develop a report synthesizing the results of research relating to key animal welfare issues, as identified by the Scientists' Committee and the Code Development Committee. The report will be used by the Code Development Committee in drafting a Code of Practice for the species in question.

The full Terms of Reference for the Scientists' Committee can be found within the NFACC Development Process for Codes of Practice for the Care and Handling of Farm Animals, available at www.nfacc.ca/code-development-process#appendixc.

CODE OF PRACTICE FOR THE CARE AND HANDLING OF RANCHED FOX (*Vulpes vulpes*): REVIEW OF SCIENTIFIC RESEARCH ON PRIORITY ISSUES

Ranched Fox Code of Practice Scientists Committee
April 2012

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1. INTRODUCTION

In many areas of fur animal research, there are few researchers working on few topics. In most cases, research is performed only on one or few farms using one species. This may mean that scientific conclusions cannot be attained in some cases. A large majority of the research is also performed in countries outside North America (particularly Scandinavian countries) and in some cases may not be transferable to North American practices.

As silver foxes (*Vulpes vulpes*) are by and large the only species of farmed fox in Canada, the review of the literature is centered on this species, and may not be applicable to other species, such as the blue fox (*Vulpes lagopus*). Where appropriate, North American industry terms were used as well (e.g. pups in place of cubs).

2. PHYSICAL ASPECTS OF HOUSING

CAGE SIZE AND SPACE ALLOCATION

Conclusions:

1. **Adjusting the cage size alone without enriching the environment does not significantly improve the welfare of silver foxes, at least from floor areas of 1.21m^2 to 15m^2 (13.02ft^2 to 161.46ft^2) with heights of 70cm (27.6in) or greater, but this conclusion is based on extremely limited research.**

2. **Space allocation per animal has minimal effects on silver foxes, but females are found to have more bites inflicted when housed with a space allocation of 0.6m^2 (6.5ft^2) per fox compared to 1.2m^2 (12.9ft^2) per fox.**

Welfare science is moving away from engineering standards, such as x m^2 and more towards animal-based standards, where certain outcomes must be met, such as certain behaviours must be able to be performed. It is unlikely that these standards will be able to be used to determine a universal engineering standard. The requirements based on animal-outcomes may vary with strain, species and country, among other factors.

Farmed foxes are generally kept individually or as pairs in cages. As reviewed below, cage sizes researched to date seem to have minimal impact on the welfare of the fox, unless the cages are extremely small. Space allocation has minimal impact on foxes, yet a small space allocation can cause reduced fur quality and increase bite wounds on females.

Cage size: The impact of cage size on silver foxes has received little attention in scientific literature. The sizes encompassed in this literature review can be found in Table 1. Nimon and Broom (2001) surmised that the behavioural evidence does not suggest that a large increase in cage size is of value to farmed foxes. This is particularly true if the additional area does not provide further complexity or enrichment. Research has shown that juvenile blue foxes raised paired in small cages (50cm L x 105cm W x 70cm H [19.7in L x 41.4in W x 27.6in H]) may have compromised welfare because their movement is restricted (Korhonen et al., 2001).

Results reviewed by the European Commission (2001) suggest that silver foxes in large cages respond to humans with aggression less often than those in smaller cages, but no other significant differences between animals housed in different sized cages were noted. Animals housed in small cages appear to have increased aggression due to a lack of control over their proximity to humans. However, Ahola et al. (2000) found that silver foxes housed in large, soil floor enclosures (7.5m x 15m or 5m x 10m [24.6ft x 49.2ft or 16.4ft x 32.8ft]) become desocialized to humans and thus suffer short term stress when they are in the proximity of humans. This reduced socialization is related to the foxes' innate fear of humans which causes them to flee from humans when increased space is allowed. While the animals may have increased stress during handling procedures or close proximity to humans, it is likely that the choice to increase space or flee from humans may improve the animals' sense of control. This effect can be somewhat combated, but not entirely prevented, by prolonging the initial period spent in cages from 8 weeks to 16 weeks (Ahola et al., 2001).

Cage size recommendations from other countries: Norwegian regulations (Norway, 2011) state that fox cages should have a height of at least 75cm (29.6in). The floor area for a single adult animal weighing less than 20kg, with or without pups under 3 weeks of age must be at least 1.2m^2 (12.9ft^2), while an adult weighing equal or greater than 20kg and/or with pups at least 3 weeks of age must have 2.0m^2 (21.5ft^2), and weaned pups must have 1.2m^2 (12.9ft^2), with an additional 0.5m^2 (5.4ft^2) for every animal with cage occupancy greater than two. Norwegian regulations (Norway, 2011) state "Rev skal ha adgang til så stor del som mulig av anleggets oppholdsareal gjennom hele året". Translated as: "The foxes must be given access to as much as possible of the farm's living space throughout the year". Argentine recommended codes of practice state that "no accommodation shall be less than 75cm [29.6in] wide excluding nest box" and "no accommodation shall be less than 100cm [39.4in] long excluding nest box" and "the minimum height of any accommodation shall be of 70cm [27.6in]" (Argentine Federation for the Commercialization and Industrialization of Fauna, 2008). Cages in Europe generally have a floor area of 0.6-1.2m^2 (6.5-12.9ft^2) and are 60-75cm (23.6-29.6in) tall (European Commission, 2001). Chinese regulations for housing foxes state that the activity area for each breeding fox must be no less than 0.54m^2 and the total area must not be less than 0.63m^2 (Chinese State Forestry Administration, 2006). A comparison of these regulations or standards can be seen in Table 2.

Space allocation: Space allocation of 0.6m^2 (6.5ft^2) or 1.2m^2 (12.9ft^2) per animal when examined in juvenile silver foxes was not found to result in significant differences in the time spent performing locomotor stereotypies or in physiological parameters (urinary cortisol-creatinine ratio, stress-induced hyperthermia and serum cortisol level after adrenocorticotropic hormone [ACTH] administration) (Ahola et al., 2002). However, the authors also speculated that larger space allocation enabled the animals to exercise more (i.e. cubs that were housed with larger space allocation (1.2 m^2) (12.9ft^2) had heavier hearts than the cubs housed at 0.6 m^2 per animal). Larger space allocation also gives group-housed silver foxes possibilities to avoid close contacts with their cage mates, e.g. during their natural dispersal time (Ahola et al., 2002).

Juvenile females housed in groups with smaller space allocation (0.6m^2) (6.5ft^2) had more bites inflicted compared to those housed with 1.2m^2 (12.9ft^2), yet no effect of space allocation was seen with bite wounds on males (Ahola et al., 2002). Fur quality also decreased with increasing

group size and decreasing space allocation (i.e. four silver foxes housed with $0.6m^2$ ($6.5ft^2$) per fox).

Table 1: Cage size and space allocation comparisons from reviewed scientific literature.

Reference	Cage dimensions		Cage height		Floor area		Cage volume		Number of animals per cage or enclosure	Space allotment per animal		Country where work was completed
	L*W (cm)	L*W (inches) [§]	cm	inches[§]	$m^{2§}$	$Ft^{2§}$	$m^{3§}$	$ft^{3§}$		$m^{2§}$	$ft^{2§}$	
Ahola et al., 2000	115*105	45.3*41.4	70	27.6	1.21	13.02	0.85	30.02	1	1.21	13.02	Finland
	750*1500	295.3*590.6	n/a	n/a	112.50	1210.94	n/a	n/a	5	22.50	242.19	
	500*1000	196.9*393.7	n/a	n/a	50.00	538.20	n/a	n/a	5	10.00	107.64	
Ahola et al., 2002	115*105	45.3*41.4	70	27.6	1.21	13.02	0.85	30.02	1	1.21	13.02	Finland
	115*105	45.3*41.4	70	27.6	1.21	13.02	0.85	30.02	2	0.61	6.57	
	2(115*105)	2(45.3*41.4)	70	27.6	2.42	26.05	2(0.85)	2(30.02)	2	1.21	13.02	
	2(115*105)	2(45.3*41.4)	70	27.6	2.42	26.05	2(0.85)	2(30.02)	4	0.61	6.57	
	4(115*105)	4(45.3*41.4)	70	27.6	4.84	52.08	4(0.85)	4(30.02)	4	1.21	13.02	
Ahola et al., 2001	115*105	45.3*41.4	70	27.6	1.21	13.02	0.85	30.02	1	1.21	13.02	Finland
	750*1500	295.3*590.6	n/a	n/a	112.50	1210.94	n/a	n/a	4	22.50	242.19	
	500*1000	196.9*393.7	n/a	n/a	50.00	538.20	n/a	n/a	4	10.00	107.64	

[§]Shaded areas represent a calculated or unit-converted number based on authors original work

Table 2: Cage size recommendations or requirements from other countries.

Country	Floor Dimensions		Cage Height		Floor Area		Reference
	L*W (cm)	L*W (in)[§]	cm	in[§]	m^2	$ft^{2§}$	
Finland	100*75	39.4*29.6	Minimum 70	Minimum 27.6	Single adult: 0.8 Adult with pup(s): 2.0 Weaned pups: 1.2; 0.5 for every animal above two	Single adult: 8.6 Adult with pups: 21.5 Weaned pups:12.9; 5.4 for every animal above two	Finland, 2011
Norway	--	--	Minimum 75	Minimum 29.6	Single adult ≥ 20kg: 2.0 Single adult < 20kg: 1.2	Single adult ≥44.1lbs: 21.5 Single adult < 20kg: 12.9	Norway, 2011
Denmark	Minimum 200 *100	Minimum 78.7*39.4	Minimum 75	Minimum 29.6	Single adult: 2.0 Adult with pup(s): 2.0 Weaned pups: 2.0; minimum $0.02m^2$/kg; 1.0 for every animal above two	Single adult: 21.5 Adult with pup(s): 21.5 Weaned pups: 21.5; minimum $0.22ft^2$/kg; 10.8 for every animal above two	Denmark, 2006
Argentina	--	--	Minimum 70	Minimum 27.6	Single adult: 0.8 Adult with pups: 2.0 Weaned pups: 1.2; 0.5 for every animal above two	Single adult: 8.6 Adult with pups: 21.5 Weaned pups:12.9; 0.5 for every animal above two	Argentine Federation for the Commercialization and Industrialization of Fauna, 2008
China	--	--	--	--	0.63 total area; 0.54 activity area	6.78 total area; 5.81 activity area	Chinese State Forestry Administration, 2006
European Recommendations	Minimum 100*75	Minimum 39.4*29.6	Minimum 70	Minimum 27.6	Single adult: 0.8 Adult with pups: 2.0 Weaned pups: 1.2; 0.5 for every animal above two	Single adult: 8.6 Adult with pups: 21.5 Weaned pups:12.9; 0.5 for every animal above two	Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP), 1999

[§] shaded areas represent a calculated or unit-converted number based on authors original work

-- indicates data were not available from source paper

Outstanding issues that are not addressed in current scientific literature:

How different are the current housing practices of silver foxes between Canada and Europe? In general, how translational are the European results to Canadian farms?

What impact does cage size have on the welfare (e.g. abnormal behaviour and physiology) of silver foxes?

Does the configuration of the cage affect the behaviour and/or the welfare of silver foxes?

References

Ahola L., Harri M., Kasanen S., Mononen J., & Pyykönen T. (2000) Effect of family housing of farmed silver foxes (*Vulpes vulpes*) in outdoor enclosures on some behavioural and physiological parameters. *Canadian Journal of Animal Science* 80:427-434.

Ahola L., Harri M., Mononen J., Pyykönen T. & Kasanen S. (2001) Welfare of farmed silver foxes (*Vulpes vulpes*) housed in sibling groups in large outdoor enclosures. *Canadian Journal of Animal Science* 81:435-440.

Ahola L., Mononen J., Pyykönen T., Mohaibes M. & Rekilä T. (2002) Effects of group size and space allocation on physiological, behavioural and production-related welfare parameters in farmed silver fox cubs. *Agricultural and Food Science in Finland* 11:185-196.

Argentine Federation for the Commercialization and Industrialization of Fauna (2008) *Code of practice recommended for the care and handling of minks, fitches and foxes in Argentine farms*. Buenos Aires AR: Argentine National Environment Secretary.

Chinese State Forestry Administration (2006) *Provisional regulation governing the technical management of breeding, keeping and housing of fur farmed animals*. CHN: Chinese State Forestry Administration.

Denmark (2006) Bekendtgørelse om beskyttelse af pelsdyr, nr. 1734 af 22. (Order on the protection of fur, in Danish). DK: Justitsministeriet.

European Commission (2001) *The Welfare of Animals Kept for Fur Production –Report of the Scientific Committee on Animal Health and Animal Welfare.* Brussels BE: European Commission, Health and Consumer Protection Directorate.

Finland (2011) Valtioneuvoston asetus turkiseläinten suojelusta. (Council of State decree regarding protection of fur animals, in Finnish). Helsinki FI: Maa- ja Metsätalousministeriö. Available at http://www.finlex.fi/fi/laki/alkup/2011/20111084

Korhonen H., Jauhiainen L., Niemelä P., Harri M. & Sauna-aho R. (2001) Physiological and behavioural responses in blue foxes (*Alopex lagopus*): Comparisons between space quantity and floor material. *Animal Science* 72:375-387.

Nimon A.J. & Broom D.M. (2001) Welfare of farmed foxes *Vulpes vulpes* and *Alopex lagopus* in relation to housing and management: A review. *Animal Welfare* 10:223-248.

Norway (2011) Lovdata: FOR 2011-03-17 nr 296: Forskrift om hold av pelsdyr (OR 2011-03-117 No. 296: Regulations relating to the keeping of fur, in Norwegian). NO: Landbruks- og matdepartementet.

Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP) (1999) *Recommendations concerning fur animals*. Strasbourg FR: Council of Europe. Available at http://www.efba.eu/download/1_recommendation_concerning_fur_animals.pdf

ENVIRONMENTAL ENRICHMENT (PLATFORMS)

Conclusions:

1. **Platform use by silver foxes is variable and platforms are most often used for resting as well as for observation of surroundings. Platforms also seem to reduce fear of humans.**

2. **Platforms with solid floors, if they are wet, do not provide thermoregulatory benefits to silver foxes.**

Norwegian regulations state that fur animals shall have access to objects which can stimulate natural behaviour (Norway, 2011). The Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (1999 [European Convention]) also recommends that:

> "The environment shall be enriched with objects that provide suitable stimuli to gnaw and any other occupational material."

and

> "Foxes must be able to conceal themselves from people and from animals in other cages or enclosures. They must also be able to rest and to observe their surroundings. Each weaned animal shall have available:
>
> a. a secluded area;
>
> b. either an elevated platform or a nest box with a roof on which the animal can rest and observe the cage door or enclosure entrance."

Enrichment should provide animals with environmental features that are required for performing certain behaviour patterns or that provide the animal with a more stimulating environment.

While the use of environmental enrichments outside of platforms has not been studied in silver foxes, practical experience on farm has shown that foxes use a variety of objects such as small plastic balls, cylinders, bottles, turnips, etc. (Koistinen et al., 2010). Year-round nest boxes may also be considered a form of environmental enrichment; and these are discussed later in this report in the section on *Nest Box Requirements*.

Platforms are used most often for resting, as foxes prefer an elevated resting place, and as such should be large enough to allow the fox to adopt a curled position. Usage is somewhat variable between individuals, but increases when views from the floor of the cage are obstructed, as foxes have been found to prefer areas where their view is unobstructed (Mononen et al., 1998a). The duration of a behaviour also does not necessarily reflect its importance to the animal.

Solid platforms do not provide thermoregulatory benefits, and in fact appear to provide less thermal protection than the wire floor. This is because a solid platform compresses the fur coat of blue foxes and reduces its thermal insulation and also because a solid platform will freeze in the winter and the animal must heat up the surface using its own body heat (Harri et al., 1991).

It should be noted that these results were found with blue foxes, however it is likely that platforms have similar thermoregulatory properties for silver foxes. Platforms do not appear to improve comfort around resting, but may affect the welfare in other ways, such as allowing animals the opportunity to observe their surroundings, increasing behavioural flexibility and reducing their fear of humans.

Platforms used in experimental conditions have been made of a variety of shapes (rectangle, triangle, u and v-shaped bottoms, among others) and materials (wooden or plastic coated wire mesh for example) (Koistinen et al., 2010). The most common type that is currently in use in Nordic countries is made of mesh and is slightly V-shaped, narrow and long and placed along one wall of the cage and does not have solid walls (Koistinen et al., 2010).

Platform usage: Perhaps unsurprisingly, solid platform usage by juvenile silver foxes was greater when the platform restricted the free floor area that the fox could use (Mononen et al., 1998b). Platforms were also used more in cages which had views obstructed by objects in the neighbouring or in the animal's own cage (Mononen et al., 1998b). In research by Mononen (1996), it was found that juvenile foxes used platforms more than adults and females used them more than males. Heavy animals also used platforms less than lighter animals. Platforms which were open-sided were used more than those with solid walls and larger platforms were used more than smaller platforms. Furthermore, platforms with v-shaped mesh bottoms were used more than wooden, flat platforms.

Urinating and defecating does occasionally occur on the platform, but hanging platforms only 20cm (7.9in) from the roof may help to reduce this. As juvenile foxes grow this small space may impede the use of the platform, as was seen by Mononen et al. (1993). Platforms placed 23cm (9.1in) from the roof remained fairly clean and in adult silver foxes the amount of dirty platforms decreased with time (Korhonen & Niemelä, 1995). Platforms that are too close to the ceiling may be difficult for the fox to jump onto and therefore decrease the amount of use.

Wooden platform use is generally higher in the summer months as compared to the winter (Korhonen & Niemelä, 1995, 1996; Mononen et al., 1998b) and higher at night than during the day (Mononen, 1996). It is possible that the usage of wooden platforms declines as temperatures fall, since a wooden platform provides less thermal protection than a bare wire floor or wire platform due to compression of the fur coat and moisture condensation on the solid platform (Mononen et al., 1993).

Platforms are used most often for sleeping, although usage is greater in platforms without walls, suggesting that the ability for observation is important as well (Korhonen & Niemelä, 1995; Nimon & Broom, 2001). Platforms do not appear to be consistently used as a refuge for foxes (Korhonen & Niemelä, 1996). A disturbance test, which involved heavily pounding on the foxes' cage or platform with a stick (thought to elicit the strongest fear reaction), prompted less than half the animals to jump onto the platform. However, significantly more animals jumped onto the platform during the "human test" (human positioned close to the cage and established eye contact with the fox) and the "confrontation test" (human opened the cage door and reached for the fox) which may indicate that platforms are used as a refuge in response to certain situations and may be one reason why platforms seem to reduce fear in foxes.

Platform type: When comparing two types of wooden platforms using 24-hour observations, a wider flat roof-type (43cm [16.9in]) and a narrower u-shaped platform (30cm W x 105cm L [11.8in W x 41.4in L]), the wider flat type was used more (Mononen et al., 1998b). Silver foxes that had access to both types preferred the u-shaped platform in the early autumn but towards the winter the preference changed (Mononen et al., 1998b). This is possibly due to thermoregulation, with the wider platform allowing the fox to rest in a curled position with greater ease.

Implications of platforms for production and animal temperament: Platforms generally remain clean (particularly wire platforms) and although some exploratory biting does occur, the degree of biting was found to be low (Korhonen & Niemelä, 1995). Farmed foxes are generally motivated to gnaw and therefore may bite and chew on wooden platforms. An extra piece of wood or other enrichment object present in the otherwise barren cage may help to reduce this platform biting and fulfill the foxes' desire to gnaw or chew.

Silver foxes housed with a platform did not differ in reproductive success from those without, but foxes with platforms were less fearful of humans than those housed without platforms (Korhonen & Niemelä, 1996). This was evident only in a "human test", where the foxes were exposed to an unknown observer outside their cage, and whether or not they showed fear was recorded. Thirty-two control foxes were classified as fearful (fleeing or withdrawing), compared to 21 experimental foxes. There were no significant differences between groups in four other fear tests. When foxes have access to a nest box roof, they often use this in the same function as a platform (Mononen et al.1995, 1998b). Platforms seem to increase the complexity of the cage and are used for a variety of biologically appropriate behaviours by the foxes (Nimon & Broom, 2001).

Environmental enrichment objects for blue foxes: As stated earlier, enrichment objects have not been studied in silver foxes, but there is some research with these objects in blue foxes, and in this case, it is unlikely that the species differences are critical. Certain recommendations in Europe (European Convention, 1999) state: "The environment shall be enriched with objects that provide suitable stimuli to gnaw and any other occupational material." Finnish legislation (Finland, 2011) also states (translated): "Fur animals shall be provided with suitable material for gnawing and enrichment/ manipulation."

One such object that has been researched by Ahola et al. (2010) is bones for gnawing. Blue fox pups given access to cattle femur bones from four weeks of age (housed in family unit from four to eight weeks and male-female pairs during the rest of the study) did not have significantly different urinary cortisol-creatinine ratios than those without access to bones. Bones do seem valued by the fox and are a long lasting enrichment. Foxes usually used the bones for gnawing, sniffing and licking, scratching and play, or the bones were involved in social interactions (Koistinen et al., 2009).

Access to bones improves the dental health of the fox; while dental calculus was not eliminated, it was significantly less severe in foxes with access to the bones than those without (Ahola et al., 2010).

Blue foxes have been found to interact with bones for 3-4% (43-57 minutes) of the day (Koistinen et al., 2009). Bones are considered to be versatile and long-lasting activity objects that allow a variety of occupational activities and enhance play behaviours (Koistinen et al., 2009). Access to bones also prevents the development of oral stereotypies such as repetitive oral manipulation of the cage, feed bowl, etc. (Koistinen et al., 2009). On the other hand, it is suggested that the use of bones may increase competition between the male and female and may in fact jeopardize the welfare of the subordinate animal (Ahola et al., 2010). The competition may be decreased if both foxes are able to access the bone without monopolizing it (Ahola et al., 2010). Bones in the cage for an extended length of time become contaminated with feces, and should be replaced when necessary (Koistinen et al., 2009).

Wooden blocks are also used to enrich cages, and are frequently used by blue foxes, but interactions decrease slightly with time (Korhonen & Niemelä, 2000). Blue foxes show higher motivation to interact with blocks than straw (Korhonen et al., 2002). Foxes' mainly use wooden blocks for carrying, chewing, poking with their nose and sniffing (Korhonen & Niemelä, 2000). Wooden blocks as well as straw stimulate play behaviour in young blue foxes (Korhonen et al., 2002).

Wooden blocks also prevent accumulation of dental plaque and the development of hypertrophia gingiva in blue foxes (Korhonen et al., 2002). Although no differences in blood parameters or the 24-hour urinary cortisol:creatinine ratio were found, the presence of a wooden block in the cage significantly reduced the amount of oral stereotypies during the latter part of the growing season. Wooden blocks seem to be suitable stimuli to enrich barren cages and elicit more variable behaviour in foxes (Korhonen & Niemelä, 2000).

Outstanding issues that are not addressed in current scientific literature:

What function does a platform serve in the life of a silver fox?

What impact do platforms have on the welfare (e.g. abnormal behaviour and physiology) of silver foxes?

What is the potential welfare value of other types of environmental enrichment, such as objects to gnaw, objects to explore, and digging substrates, etc. for silver foxes?

References

Ahola L., Turunen A., Mononen J. & Koistinen T. (2010) Gnawing bones as enrichment for farmed blue foxes (*Vulpes lagopus*). *Animal* 4:951-957.

Finland (2011) Valtioneuvoston asetus turkiseläinten suojelusta. (Council of State decree regarding protection of fur animals, in Finnish). Helsinki FI: Maa-ja Metsätalousministeriö. Available at http://www.finlex.fi/fi/laki/alkup/2011/20111084

Harri M., Mononen J., Korhonen H. & Haapanen K. (1991) A study of the use of resting platforms by farmbred blue foxes. *Applied Animal Behaviour Science* 30:125-139.

Koistinen T., Mononen J., Hovland A.L., Korhonen H.T. & Ahola L. (2010) Expression of other behaviours. *WelFur mini-reviews 1-12: blue fox, silver fox and Finnraccoon*, pp. 93-108 [an unpublished WelFur project document].

Koistinen T., Turunen A., Kiviniemi V., Ahola L. & Mononen J. (2009) Bones as enrichment for farmed blue foxes (*Vulpes lagopus*): Interaction with the bones and preference for a cage with the bones. *Applied Animal Behaviour Science* 120:108-116.

Korhonen H. & Niemelä P. (1995) Platform use by juvenile and adult silver foxes (*Vulpes vulpes*). *Scientifur* 19:179-187.

Korhonen H. & Niemelä P. (1996) Temperament and reproductive success in farmbred silver foxes housed with and without platforms. *Journal of Animal Breeding and Genetics* 113:209-218.

Korhonen H. & Niemelä P. (2000) Enrichment value of wooden blocks for farmed blue foxes (*Alopex lagopus*). *Animal Welfare* 9:177-191.

Korhonen H.T., Jauhiainen L., Niemelä P. & Sauna-aho R. (2002) Wooden blocks and straw as environmental enrichments for juvenile blue foxes (*Alopex lagopus*). *Acta Ethologica* 5:29-37.

Mononen J. (1996) *Resting platforms and nest boxes for farmed blue foxes (Alopex lagopus) and silver foxes (Vulpes vulpes)*. Ph.D. Thesis. Kuopio FI: University of Kuopio.

Mononen J., Harri M., Rekilä T., Korhonen H. & Niemelä P. (1995) Use of nest boxes by young farmed silver foxes (*Vulpes vulpes*) in autumn. *Applied Animal Behaviour Science* 43:213-221.

Mononen J., Harri M., Rouvinen K. & Niemelä P. (1993) The use of resting platforms by young silver foxes (*Vulpes vulpes*). *Applied Animal Behaviour Science* 38:201-310.

Mononen J., Harri M., Sepponen J. & Ahola L. (1998a) A note on the effects of an unobstructed view on cage choices in farmed foxes. *Applied Animal Behaviour Science* 61:79-84.

Mononen J., Korhonen H., Harri M. & Kasanen S. (1998b) A comparison of the use of resting platforms and nest boxes in growing farmed silver foxes (*Vulpes vulpes*). *Applied Animal Behaviour Science* 58:383-396.

Nimon A.J. & Broom D.M. (2001) The welfare of farmed foxes *Vulpes vulpes* and *Alopex lagopus* in relation to housing and management: A review. *Animal Welfare* 10:223-248.

Norway (2011) Lovdata: FOR 2011-03-17 nr 296: Forskrift om hold av pelsdyr (OR 2011-03-117 No. 296: Regulations relating to the keeping of fur, in Norwegian). NO: Landbruks- og matdepartementet.

Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP) (European Convention) (1999) *Recommendations concerning fur*

animals. Strasbourg FR: Council of Europe. Available at http://www.efba.eu/download/1_recommendation_concerning_fur_animals.pdf

NEST BOX REQUIREMENTS

Conclusions

1. **Access to year-round nest boxes allows silver foxes to have increased behavioural flexibility, and likely improves their overall welfare, even though silver foxes use the nest boxes for only a small percentage of time outside the whelping season.**

2. **Silver foxes prefer nest boxes that are placed high in the cage with multiple rooms.**

3. **Whelping nest boxes equipped with an entrance tunnel can improve pup survival.**

Although most foxes spend only a small portion of time inside the nest box outside of whelping, it is important to consider that the duration of behaviour does not always reflect its importance to the animals' welfare. Housing environments that allow increased behaviour flexibility contribute to the animals' coping abilities and therefore likely improve their overall welfare.

Foxes prefer nest boxes that are positioned high in the cage, likely because of their preference for elevated resting positions, and if allowed they will often rest on the roof of the nest box compared to within it. Nest boxes may improve the welfare of the animals through increasing variation in the environment. A nest box may also provide opportunities for withdrawal for foxes (escape/withdrawal from fear releasing stimuli), and more research is needed into this possibility. Although nest boxes given free choice year-round to foxes are clearly preferred, this access may in fact increase the fearfulness of the foxes, and thus may not be ideal from a welfare point of view (Jeppesen et al., 2000).

An entrance tunnel on a whelping nest box can improve reproduction by encouraging the vixen to remain in the nest box and to care for her pups. This may be related to reduced fear due to relevant biological stimuli; the properties of tunnels may trigger increased perception of safety.

Nest box usage: When provided with a year-round nest box, juvenile silver foxes spent only 1-2% of their time in the nest box, but 40-75% of their time on the roof of the nest box (Mononen et al., 1995; 1998). When the nest box is placed on the floor of the cage, as it was in these studies, foxes prefer to rest on top of the box compared to within it, as foxes prefer raised resting places. Jeppesen et al. (2000) found that vixens outside the breeding season used their preferred type of nest box (three-room boxes placed high in the cage) 12-45% of the time, which may reflect a difference due to design of the box or age of the animal, among other things. Although the juvenile foxes used the interior of the nest box for just a small portion of the time, this does not necessarily indicate that it is not important as a hiding place, particularly since there is no escape from the cage.

Nest box requirements: The European Fur Breeders' Association (1999) Code of Practice requires each weaned animal to have access to a secluded area, which must have solid walls for silver foxes, as well as an elevated platform or nest box with a roof. Pregnant vixens and vixens with pups must have a nest box divided into an anteroom and main room.

Although nest boxes with wire mesh floors and walls are used to avoid cleanliness problems, year-round nest boxes with solid floors are used in European countries in order to meet certain

needs of foxes (Koistinen et al., 2010). Solid floors in cages for foxes were abandoned previously in order to improve hygiene and control parasites and bacterial diseases. The majority of silver foxes' resting time has been observed to be spent on the roof of the nest box if it is accessible and the extent that silver foxes rested on the roof of the year-round nest box did not appear to be affected by the cleanliness or dirtiness of the roof (Mononen et al., 1995). The availability of a solid floored nest box may cause the cleanliness of the animals' resting site to be jeopardized, which can then impact the cleanliness of the fur and the health of the animal.

Nest box preferences: Using two-choice preference tests, Jeppesen et al. (2000), found that juvenile silver fox vixens tested in autumn/winter preferred three-room nest boxes (40cm x 40cm x 120cm [15.8in x 15.8in x 47.3in]) that were placed high in the cage (height difference was 35cm [13.4in]). These were preferred over a one room box, a one room box with an entrance room or a one room box with a platform. It is unclear whether the three room cage was preferred due to the increased size or because the extra rooms mimic an entrance tunnel, as is used by wild foxes (Jeppesen et al., 2000). Silver foxes given access to a shelf and nest box at varying locations in the cage show preference for a box on top of the cage and the shelf beneath it (Pedersen & Jeppesen, 1993). When disturbed, foxes occasionally fled into the top box, but most often fled to the opposite side of the cage, suggesting that nest boxes are often not used as a refuge for silver foxes.

Effect of nest boxes on stress parameters: Foxes provided with year-round nest boxes for two consecutive years had lower levels of cortisol, suggesting that they have lower levels of stress than those provided with a nest box only during the breeding season and housed in barren cages during the rest of the year (Jeppesen & Pedersen, 1991). Foxes with year-round nest boxes also were more active and exploratory in an open field test and less fearful and passive than those without. The cortisol levels of these animals were tested only once, at two or three years of age and after the animals had been housed individually for at least two months, which may have impacted the results.

In contrast to these results, Harri et al. (1995) found that silver foxes that had access to a nest box for at least 2 months did not respond differently towards humans than those without any furnishings or with a platform. The response of these foxes during an open field test was also not affected by the cage environment to which the fox was exposed (Harri et al., 1995).

Breeding nest boxes: A breeding box that stimulates a mother to spend more time with her pups is important, as the pups rely on their mother for warmth in their first days of life (European Commission, 2001). A box equipped with an entrance tunnel appears to stimulate this, as young vixens in tunnel boxes spent more time caring for and grooming their pups than vixens housed with a traditional nest box with no entrance tunnel (Braastad, 1996). The vixens with tunnel boxes also spent more time sleeping in the nest box, whereas vixens without tunnels rested without sleeping. These differences were more pronounced during the working hours. While litter size at birth was not significantly different, litter size at seven days tended to be higher in animals housed with tunnel entrances, and the pup mortality in boxes with a tunnel entrance was significantly lower than those without a tunnel. Infanticide occurred in 15 out of 22 litters without a tunnel entrance, whereas it only occurred in 3 out of 16 litters with a tunnel entrance. These results were particularly clear for primiparous vixens. This improvement in reproduction depends on what the limiting factor of reproduction on a particular farm is, and the

improvement has only been seen on farms with previously poor or moderate reproduction (European Commission, 2001).

The use of top-mounted breeding boxes showed beneficial effects, particularly in primiparous silver vixens (Pyykönen et al., 2002). Females with top-mounted boxes raised 0.7 more pups per primiparous breeding female than females with floor boxes, and there was no significant difference between the number of pups raised by primiparous or multiparous vixens (Pyykönen et al., 2002). The top-mounted box can be successfully used as a breeding nest box. It is practical and economical and may improve the welfare of the foxes.

Open-sided whelping nest boxes: Nest boxes with a solid door that can be removed (Figure 1) to leave only a wire mesh door can decrease the level of fear in pups and help to habituate the pups to human presence (Pedersen, 1991). Silver fox pups reared with this type of an open nest box from 2 to 8 weeks showed greater levels of curiosity towards a person at both 14-16 weeks of age and 26-28 weeks of age. Pups raised in a solid sided nest box, which allowed concealment, showed fear responses more often during the same behavioural test. The pups with an open nest box have increased visual exposure to humans, and cannot hide when something frightens or disturbs them, contrary to those raised in a closed nest box. It was not investigated in this study whether the pups raised with open nest boxes had been habituated to humans or would show a reduction in other fear responses as well.

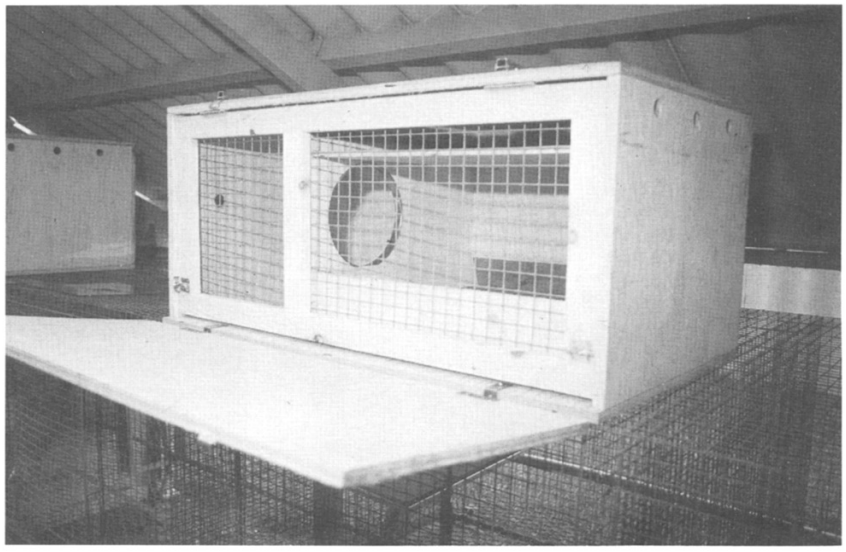

Figure 1: Open nest box mounted on the top of the cage with the solid door that faces the feed alley opened**.**

Size of the nest box: The standard nest box size (main room: 40-45cm L x 43-47cm W [15.8-17.7in L x 16.9-18.5in W] and anteroom: 23-32cm x 43-47cm [9.1-12.6in x 16.9-18.5in]) does not allow resting in stretched posture of adult foxes (Koistinen et al., 2010). Curled postures are likely possible inside the main room, but likely not in the anteroom of the nest box. Standard nest box size is also unlikely to be large enough for two animals, especially when they reach adult size, and larger nest boxes, or more available space is suggested to remedy this in animals kept in pairs or large litters (Koistinen et al., 2010). It has been recommended that all foxes have permanent access to a nest box and be able to adopt a preferred resting posture inside. In order

to meet this, nest boxes should be much larger than current sizes, or there should be more nest boxes available to the animals from pre-weaning to pelting (Koistinen et al., 2010).

Outstanding issues that are not addressed in current scientific literature:

What function does a nest box serve in the life of a silver fox, outside of the whelping period?

What is the optimal material for nest box construction; e.g. in terms of degree of insulation offered in the winter?

Do silver foxes need bedding during the whelping period and/or at other times of the year?

What is the impact of solid floored year-round nest boxes on parasite infection levels in silver foxes?

How does access to nest boxes outside of the whelping period affect the welfare of silver foxes?

References

Braastad B.O. (1996) Behaviour of silver foxes in traditional breeding boxes and in boxes with an entrance tunnel. *Animal Welfare* 5:155-166.

European Commission (2001) *The Welfare of Animals Kept for Fur Production –Report of the Scientific Committee on Animal Health and Animal Welfare.* Brussels BE: European Commission, Health and Consumer Protection Directorate.

European Fur Breeders' Association (1999) *Code of practice for the care and health of farmed mink, fitch and fox in Europe, 2nd Edition.* European Fur Breeders' Association.

Harri M., Rekilä T. & Mononen J. (1995) Factor analysis of behavioural tests in farmed silver and blue foxes. *Applied Animal Behaviour Science* 42:217-230.

Jeppesen L.L. & Pedersen V. (1991) Effects of whole-year nest boxes on cortisol, circulating leucocytes, exploration and agonistic behaviour in silver foxes. *Behavioural Processes* 25:171-177.

Jeppesen L.L., Pedersen V. & Heller K.E. (2000) Preference for various nest box designs in farmed silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*). *Applied Animal Behaviour Science* 67:127-135.

Koistinen T., Mononen J., Hovland A.L., Korhonen H.T. & Ahola L. (2010) Comfort around resting. *WelFur mini-reviews 1-12: blue fox, silver fox and Finnraccoon*, pp. 18-30 [an unpublished WelFur project document].

Mononen J., Harri M., Rekilä T., Korhonen H. & Niemelä P. (1995) Use of nest boxes by young farmed silver foxes (*Vulpes vulpes*) in autumn. *Applied Animal Behaviour Science* 43:213-221.

Mononen J. Korhonen H., Harri M. & Kasanen S. (1998) A comparison of the use of resting platforms and nest boxes in growing farmed silver foxes (*Vulpes vulpes*). *Applied Animal Behaviour Science* 58:383-396.

Pedersen V. (1991) Early experience with the farm environment and effects on later behaviour in silver *Vulpes vulpes* and blue foxes *Alopex lagopus*. *Behavioural Processes* 25:163-169.

Pedersen V. & Jeppesen L.L. (1993) Daytime use of various types of whole-year shelters in farmed silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*). *Applied Animal Behaviour Science* 36:259-273.

Pyykönen T., Asikainen J., Miettinen M., Mononen J., Sepponen J. & Ahola L. (2002) Breeding success of farmed silver foxes with top boxes [abstract]. *NJF-Seminar No. 347.* Vuokatti, FI, October 2-4, 2002. *Scientifur* 26:47-48.

3. SOCIAL ASPECTS OF HOUSING[1]

WEANING AND GROUPING

Conclusions:

1. **The welfare of the silver fox mother and pups is reduced if weaning does not take place before mid-autumn.**

2. **Silver fox pups raised individually from 8 weeks of age perform more stereotypies, than those housed in pairs or groups to approximately 6 months of age, but pups which are kept in family groups (with the vixen) often show signs of social stress.**

3. **Adult silver fox vixens are motivated to access social contact, but this motivation is much less than the motivation for food. Although some aggression and defense of resources has been seen in social housing, beneficial aspects such as increased play behaviour have been identified as well.**

Weaning method and age: There are no studies on the farmed silver fox *Vulpes vulpes* focusing on the weaning age and method on the welfare of the pups and the vixen (Koistinen et al., 2010). It is suggested that the best way to wean pups is to first remove the mother when the pups reach 8 weeks of age, however the Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (1999 [European Convention]) recommends that "Weaning of cubs shall take place at an age which is most beneficial to the welfare of the mother and the cubs". It has also been recommended that "Weaned cubs should not be left in the vicinity of their mother" (European Convention, 1999).

Subsequently, the litters are generally split into male-female pairs, yet this has not been adequately researched, and is based on positive production experiences (Ahola et al., 2006). It has been shown that 9-week-old female silver fox pups prefer social contact with a conspecific of the same age (either familiar or unfamiliar) compared to an empty cage (Akre et al., 2009). This was not seen at 24 weeks of age; females showed no preference between social contact and an empty cage and exhibited aggressive behaviour towards unfamiliar conspecifics. In the wild, *Vulpes vulpes* begin to disperse in September, when the pups are approximately 4 to 6 months of age, although not all animals (particularly females) disperse in the first year (Storm et al., 1976; Bakken & Hovland, 2000).

If weaning does not occur, the welfare of the mother and her pups may be compromised (Ahola et al., 2000; Ahola, 2002). Family housing in enlarged cages is only a viable alternative until mid-autumn (Ahola & Mononen, 2002). After this, aggression between family members increased and family members resisted each other, suggesting that the system was no longer beneficial. When the vixen was left with her litter, an increase in hypothalamic-pituitary-adrenal (HPA)-axis activity was seen in the pups, indicating they were under more long-term stress than control animals. Increased aggression was also seen in litters housed with their mothers (Ahola,

[1] This section was formerly identified as *Animals in the Housing*

2002). Male pups housed with their mothers had the highest serum cortisol concentration after ACTH administration when compared to both females housed in family groups and males and females housed singly in traditional cages. The number of bite scars on the leather side of the skin was higher in pups housed in groups in enclosures compared to pups that were housed singly in cages (Ahola, 2002). Social environment also affects fur quality, with the quality of furs deteriorating with increased number of foxes housed within a unit and by decreased space per individual fox (Ahola, 2002).

Juvenile housing: Pups raised individually from weaning at 8 weeks began performing stereotypic behaviours earlier than pups raised in litters until September 30 (approximately 6 months of age) and then raised individually (Ahola et al., 2006) and spent significantly more time in locomotor stereotyped behaviour than pups housed in pairs or quartets until pelting (Ahola et al., 2002). Pups that were maintained in litter groups until pelting showed practically no stereotypies (Ahola et al., 2006). It was also found that pups kept in litter groups showed significantly lower serum cortisol levels after ACTH administration (Ahola et al., 2006) whereas Ahola et al. (2002) found group size had no significant effects on HPA-axis activity.

Pups raised in sibling groups of two females and two males in outdoor enclosures from approximately 16 weeks of age did not differ from individually housed juveniles raised in traditional fox cages in cortisol levels after ACTH administration, and yet bite scars were significantly more common in foxes housed in the outdoor group enclosures (Ahola et al., 2001). Conversely, pups raised in family groups have been found to have higher serum cortisol levels after ACTH administration than those raised individually in cages, suggesting that pups raised in family groups beyond the time for natural dispersion (October /November) suffer from long-term stress, possibly due to social stressors (Ahola et al., 2000). The vixen was present in these groups, suggesting that social stress is increased by her presence and the delay of weaning. While red foxes in the wild do occasionally form groups, it is possible that grouping animals without allowing them the opportunity to disperse may increase their stress (Ahola et al., 2000). This is particularly true for males.

In other research, juvenile females housed in pairs from September to December showed more stereotypic head twirls than individually housed controls (68.8% of paired foxes vs. 50% of controls, significance not given) (Hovland et al., 2007). On the other hand, young vixens do seem motivated for social contact with their peers (Hovland et al., 2008), so the social housing of young foxes with each other, at least for females, may have some welfare benefits.

Vixens 7-8 months old were trained to use an operant apparatus in order to measure motivational strength and resource value of both food and social contact. It was found that the maximum price paid for social contact was approximately one-third of the maximum paid for food (Hovland et al., 2008). On average, when access to another fox was almost free, the test fox visited the cage frequently and spent almost half of the day with the other fox.

The vixens were typically seen to fight during the initial encounter, but serious aggression was not seen thereafter (Hovland et al., 2008). Behaviour in further interactions was characterised by social behaviours such as sniffing and grooming, play signals and agonistic displays, most frequently the gaping signal (Hovland et al., 2008). These results show that vixens do value social contact, and aggression is not excessive when the animals are still fairly young.

Effect of group housing on fur quality: No significant differences were found regarding fur characteristics between pups raised in litter groups, pups raised individually from weaning or in pups raised in litter groups until September 30, and individually thereafter (Ahola et al., 2006). Fur quality did decrease with increasing group size in silver foxes housed in groups until pelting (Ahola et al., 2002). The number of bite scars as well as the percentage of bite scars was highest in foxes raised in litter groups (Ahola et al., 2006).

Group and pair housing of adult vixens: One important aspect of pair housing adult vixens is access to important resources. The dispersion of important resources can impact social behaviour, weight gain and injuries in pair-housed foxes in the first month after mixing. Vixens which are housed with dispersed resources gain more weight and have fewer injuries, but the number of observed aggressive behaviours did not vary between dispersed or clustered resource treatments (Akre et al., 2010). Aggressive displays and chasing both decreased with time as the dominance relationship was established. Play behaviour increased with time, suggesting that pair housing may have a positive impact on the welfare of vixens (Akre et al., 2010).

Adult silver fox vixens show motivation for social contact with a vixen of the same age, but the maximum price paid for this contact was much lower than the price paid for food (Hovland et al., 2011). Interactions between the adult vixens were, for the most part, pleasant. The apparent motivation for seeking social contact varied between animals from aggression, play and social resting (Hovland et al., 2011). Because some individuals seek social contact with the apparent motivator being aggression, if social housing is incorporated, an opportunity for retreat may be necessary.

Adult vixens mixed into triplet groups often showed aggression after mixing, and fights occurred in 92% of groups within the first hour; this high level of aggression seen after mixing is likely highly stressful (Hovland et al., 2010). Vixens that were socially dominant weaned one more cub compared to subordinate vixens.

Although the aggression does decrease with time it was still found in 30% of groups 3 days after mixing and scabs and/or injuries were also found on 58.3% of animals 1 week after mixing (Hovland et al., 2010). Hovland & Bakken (2010) also found a significantly higher level of injuries in group housed vixens than singly housed vixens throughout the duration of 13 week group housing experiment. Serious injuries can occur in group housing and close attention must be paid after mixing to remove injured or very aggressive animals from the social group (Hovland et al., 2010). Severe injuries can in some cases become infected, causing further debilitation of the animal (Hovland et al., 2010).

Group housed vixens gained more weight, and were heavier at the end of the 13 week experiment than singly housed controls (Hovland & Bakken, 2010). In other results, weight loss was highest in animals with injuries (group housed), which could have been in part due to subsequent infections, or could have been due to the social competition, among other reasons (Hovland et al., 2010). Group housed vixens mated significantly earlier than singly housed vixens, and also whelped earlier (Hovland & Bakken, 2010).

No other effects were seen on reproduction. Potential benefits of social contact between vixens such as social grooming and play were rarely observed in the vixens (Hovland et al., 2010).

While social housing of young vixens does not seem to have deleterious effects, few benefits seem to be gained from socially housing adults in these current systems.

Outstanding issues that are not addressed in current scientific literature:

What is the optimal weaning age for silver foxes?

What is the optimal type and duration of social housing for young silver foxes after weaning (e.g. pairs versus groups versus solitary, and whether this varies with pup gender)?

References

Ahola L. (2002) *Effects of social and physical housing environment on the welfare in silver foxes (Vulpes vulpes)*. Ph.D. Thesis. Kuopio FI: University of Kuopio. Available at http://www.uku.fi/vaitokset/2002/isbn951-781-243-4.pdf

Ahola L., Harri M., Kasanen S., Mononen J. & Pyykönen T. (2000) Effect of family housing of farmed silver foxes (*Vulpes vulpes*) in outdoor enclosure on some behavioural and physiological parameters. *Canadian Journal of Animal Science* 80:427-434.

Ahola L., Harri M., Mononen J., Pyykönen T. & Kasanen S. (2001) Welfare of farmed silver foxes (*Vulpes vulpes*) housed in sibling groups in large outdoor enclosures. *Canadian Journal of Animal Science* 81:435-440.

Ahola L. & Mononen J. (2002) Family break-up in farmed silver foxes (*Vulpes vulpes*) housed in enlarged cage systems as families. *Acta Ethologica* 4:125-127.

Ahola L., Mononen J., Pyykönen T. & Miskala M. (2006) Group housing of farmed silver fox pups. *Animal Welfare* 15:39-47.

Ahola L., Mononen J., Pyykönen T., Mohaibes M. & Rekilä T. (2002) Effects of group size and space allocation on physiological, behavioural and production-related welfare parameters in farmed silver fox cubs. *Agricultural and Food Science in Finland* 11:185-196.

Akre A.K., Bakken M. & Hovland A.L. (2009) Social preferences in farmed silver fox females (*Vulpes vulpes*): Does it change with age? *Applied Animal Behaviour Science* 120:186-191.

Akre A.K., Hovland A.L. & Bakken M. (2010) The effects of resource distribution on behaviour in pair housed silver fox vixens (*Vulpes vulpes*) subsequent to mixing. *Applied Animal Behaviour Science* 126:67-74.

Bakken M. & Hovland A.L. (2000) *The Welfare Situation of Farmed Foxes in Relation to Domestication Status and Compared to Other Farmed Species*. Ås NO: Agricultural University of Norway.

Hovland A.L., Akre A.K. & Bakken M. (2010) Group housing of adult silver fox (*Vulpes vulpes*) vixens in autumn: Agonistic behaviour during the first days subsequent to mixing. *Applied Animal Behaviour Science* 126:154-162.

Hovland A.L., Akre A.K., Flø A., Bakken M., Koistinen T. & Mason G.J. (2011) Two's company? Solitary vixens' motivations for seeking social contact. *Applied Animal Behaviour Science* 135:110-120.

Hovland A.L. & Bakken M. (2010) Group housing of adult silver fox (*Vulpes vulpes)* vixens during autumn and its consequences for body weight, injuries and later reproduction: A field study. *Applied Animal Behaviour Science* 127:130-138.

Hovland A.L., Hansen C., Svensson H.C. & Bakken M. (2007) Pair housing in young silver fox vixens: some behavioural and reproductive consequences. *Scientifur* 31:90-91.

Hovland A.L., Mason G.J., Kirkden R. D. & Bakken M. (2008) The nature and strength of social motivations in young farmed silver fox vixens (*Vulpes vulpes*). *Applied Animal Behaviour Science* 111:357-372.

Koistinen T., Mononen J., Hovland A.L., Korhonen H.T. & Ahola L. (2010) Expression of social behaviours. *WelFur mini reviews. 1-12: blue fox, silver fox and Finnraccoon*, pp. 78-92 [an unpublished WelFur project document].

Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP) (European Convention) (1999) *Recommendations concerning fur animals*. Strasbourg FR: Council of Europe. Available at http://www.efba.eu/download/1_recommendation_concerning_fur_animals.pdf

Storm G.L., Andrews R.D., Phillips R.L., Bishop R.A., Siniff D.B. & Tester J.R. (1976) Morphology, reproduction, dispersal, and mortality of Midwestern red fox populations. *Wildlife Monographs* 49:3-82.

BEHAVIOURAL MANAGEMENT (MANAGING FEARFULNESS/STRESS)

Conclusions:

1. **Selection for confidence, early handling and the use of positive reinforcement all help to manage fearfulness in silver foxes and may also enhance reproductive output and welfare of the animals.**

2. **Handling animals at a young age can have beneficial behavioural and physiological effects.**

Behaviour tests: Many behaviour tests have been developed to measure the temperament of foxes, including, but not limited to: the stick test, the tidbit test, the feeding test, the Novosibirsk test and the strike test (see Table 3) (European Commission, 2001; Koistinen et al., 2010). The feeding test is considered by Koistinen et al. (2010) to be the most valid, feasible and reliable test to measure fear of humans in the silver fox. The feeding test involves delivering the feed on the roof of the cage or in the middle of the food tray, after which the experimenter stays in front of the cage and whether or not the fox begins to eat within 30s is recorded (Rekilä et al., 1997). Rekilä et al. (1997) found that the percentage of animals that ate over successive feedings increased, suggesting that the animals' habituated to the test, but repeatability is considered to be good, as is inter-observer reliability. The tidbit test is similar to the feeding test and measures similar features (i.e. foxes' fear of humans) (Rekilä et al., 1997). The tidbit (generally a dog biscuit) is held through the wire and whether or not the animal takes the tidbit within a predetermined time period (15-30s) is recorded.

Table 3: Behaviour tests used to measure or select for temperament in foxes (European Commission, 2001; Koistinen et al., 2010).

Test	Measurement
Feeding test*	Observe whether the fox starts eating within 30s with a human near the cage
Tidbit test	Observe whether the fox takes a food tidbit from a human's hand within 20s
Novosibirsk test*	Fearfulness score based on postures and behaviours as an experimenter approaches the cage
Human test	Reaction of the fox to a human by means of body posture and ear position
Strike test	Reaction of the fox to the experimenter raising their hand and quickly moving it towards the cage without touching the cage
Stick/pencil test	Reaction of the fox to a tongue spatula being inserted through the cage wire
Open field test	The fox is placed in an unfamiliar test arena and its behaviour is observed.
Confrontation test	The behaviour of the fox is recorded as the experimenter goes to the cage, opens it and reaches out to the fox as if trying to capture it

* Indicates tests that have been properly validated.

Effects of selection: Confidence should be an important part of the decision of which animals to breed to give less fearful and more confident animals in subsequent generations (Akre et al., 2008). Bakken et al. (1999) asserted that improvement of the human-animal relationship is

necessary when considering the welfare of silver foxes, as the presence of humans caused stress-induced hyperthermia (SIH) in adult vixens. Unfortunately, heritability of confidence is estimated at close to 0.20 in silver foxes, which is considered low (European Commission, 2001); thus selection will need to occur over multiple generations for strong effects to be seen.

The strongest evidence for the effects of selecting for tameness or confidence in the silver fox is derived from Belyaev (1979; 1984/85) and continued on by Trut (1999). Years of rigorous selection for tameness (the only animals selected for breeding consistently showed 'tame behaviour'; the experimenter offers food while trying to stroke or handle the pup) has led to all foxes within the research group being considered tamer than even the calmest commercial farm-bred foxes. In the sixth generation of selection, another category was added in order to describe foxes which were eager to establish human contact, whimpering to attract attention and sniffing and licking experimenters, similar to domestic dogs. This selection has resulted in pups that show fear responses at a later age, which is accompanied by a delay in the rise of plasma levels of corticosteroids. The basal level of corticosteroids has also been remarkably reduced in the selected foxes. Certain physical and morphological traits have changed, with the appearance of piebald coat colours (undesirable on a commercial farm) and decreased cranial height and width. Reproductive changes have also appeared, with sexual maturity occurring earlier, litters being larger and the occasional appearance of out-of-season breeding.

Behaviour in both a feeding test and tidbit test differed significantly between foxes that had been selected for tameness and control animals that were not selected for tameness (Harri et al., 2003). The selected and unselected foxes and hybrids of the two were easily distinguished by fearfulness, even by observers with no experience or information of the foxes. Serum cortisol, both when measured as a baseline level and in response to an open field was also significantly lower in the selected foxes versus unselected foxes (Harri et al., 2003).

The reproductive performance of the vixen appears to be somewhat related to her response to humans. In some years, vixens selected for confidence gave birth to and weaned more pups when compared to non-selected vixens, while in other years, no differences have been seen (European Commission, 2001). Vixens that weaned the most pups positioned themselves closer to the experimenter in a stick test as well as had a shorter latency, and greater tendency, to make contact with the stick (Kristensen, 1988). On the other hand, Kristensen (1988) found no significant relationship between the time to capture a vixen with neck-tongs and her litter-size. There was also no relationship found between the litter size and the latency to contact a ball placed inside the home cage.

Early handling: Handling has been used in domestic species to affect the long term behavioural responses to humans. Handling animals can potentially establish a positive human-animal relationship, and help animals cope with different and sometimes aversive routine management practices on farm (European Commission, 2001). The changes seen in handled animals could be caused by imprinting, which affects the social bond between the animals and humans, but results indicate that perhaps early experiences affect stress sensitivity and thus behavioural and physiological reactions (Pedersen & Jeppesen, 1990). Typical handling involves taking the animal out of its cage, holding it for some time, and returning it to its cage. Generally, animals that are handled more show less fear of humans and novel stimuli and more exploratory responses in novel environments (Pedersen, 1991).

Pups handled from 2 to 8 weeks as well as control pups both had an increase in cortisol concentration after an open field test, with the handled groups showing a higher cortisol level than the control group (Pedersen & Jeppesen, 1990). These results may indicate that the response to early handling may not be generalized to all situations.

Gentle vs. forced/ minimal handling: Pups 'fondled' and talked to in the nest box or cage for two-5 minute periods 6 days a week from 2 to 8 weeks of age have been found to be less fearful and more exploratory in response to people they had previous experience with when compared to control pups with minimal handling (Pedersen & Jeppesen, 1990). The same animals were also tested using an open field test, and while there was no difference between the groups in the capture time, a higher number of handled pups screamed, hissed and bit at the neck tongs during capture in their home cage and in the open field. The authors suggest that these reactions are typical of a non-stressed animal reacting to an acute stressor, whereas the "acceptance" of being caught is a typical response of a long-term stressed animal (Pedersen & Jeppesen, 1990). Another possible explanation is that the increased reaction does in fact indicate fear and stress of being captured in the handled foxes and that perhaps the exposure to humans during the sensitive period changed how they display this fear and stress. More pups that had been handled made contact with a novel object more frequently than the control pups (Pedersen & Jeppesen, 1990). The results were fairly consistent across several ages, and the authors suggest that the changes in behaviour are permanent.

Handling of pups reduced fear responses when performed three weeks or more during and post-weaning, but fear responses increased in handled foxes after capturing them with neck tongs and taking a blood sample (Pedersen, 1992). Silver foxes which were handled gently (offered a tidbit and if the pup approached an attempt was made to fondle the animal unless it became distressed) from 8-11 weeks of age were significantly more exploratory during a human-approach test at 30 weeks of age when compared to control animals. Foxes which were handled forcefully (caught by hand and transported to a small cage; after two minutes captured again and returned to its home cage) during the same period did not respond significantly different to the human-approach test than control animals (Pedersen, 1993). Control animals reacted significantly more fearfully when a human reached out toward them in their home cage (confrontation test) than either gently handled animals and forcefully handled animals. Gentle handling may reduce fearful behaviour in silver foxes more effectively than forced handling, although forced handling does provide some fear reduction (Pedersen, 1993). Forced handling does appear to provide a more general reduction in fearfulness than gentle handling, and the animals become less emotional and more adaptive to environmental stressors.

Exposure to humans: Increased exposure to humans in the sensitive period may also improve the reaction of foxes to humans. Pedersen (1991) found that silver fox pups reared with an open nest box (see Figure 1, wire mesh door, preventing the pups from concealing themselves) from 2 to 8 weeks showed greater levels of curiosity towards a person at both 14-16 weeks of age and 26-28 weeks of age. Pups raised in a solid sided nest box, which allowed concealment, showed fear responses more often during the same behavioural test. It was not investigated in this study whether the pups raised with open nest boxes had been habituated to humans or would show a reduction in other fear responses as well.

Foxes raised in cages receive close contact with humans on a regular basis, while those raised in outdoor enclosures receive much less exposure to humans. These animals can, and do avoid humans and as such may experience the presence of humans and restraint as more stressful than foxes raised in cages where exposure to humans is increased (Ahola et al., 2000). This may be prevented by prolonging the time spent in cages initially. Ahola et al. (2001) found no difference in cortisol levels after ACTH administration in juveniles kept in enclosures from 16 weeks of age, whereas when the juveniles were moved into the enclosures at 8 weeks of age, differences are apparent (Ahola et al., 2000). It was noted however, that silver foxes in enclosures continued to flee when a human entered the enclosure.

Long term effects of handling: Silver vixens which were either forcefully handled (captured by hand and carried to a small cage; after two minutes captured again and returned to the home cage) or gently handled (handler placed herself in front of an opened cage door, talked gently to the fox and offered raw liver to the fox; if the fox approached the handler attempted to fondle it) from 8 to 11 weeks of age showed fewer flight responses as juveniles and as adults when approached by a human than control foxes which received no additional handling as pups (Pedersen, 1994). No differences were found between gently or forcefully handled animals when they were tested as juveniles, while forcefully handled animals fled less than gently handled and control animals when confronted by a human as adults. Control animals fled more than handled animals when exposed to a novel object as adults (Pedersen, 1994). Urinary cortisol concentrations did not differ between the three groups (Pedersen, 1994).

Tidbit handouts and their effects on production: Regular tidbit handouts (a small tasty bit of food) provide positive reinforcement and reduce the fear of humans. These can be given after handling and/or regularly as part of daily management (Akre et al., 2008). Tidbits delivered as part of daily management also provide an improved opportunity to monitor the animal's health.

Vixens that received tidbits after mating, compared to vixens that received the same amount and duration of human contact but without any tidbit (considered to be under greater stress during pregnancy) gave birth to, and weaned more, male pups, yet no difference in the total number of pups born or weaned at 49 days was seen (Bakken, 1998). Male-biased sex ratios have been thought to be correlated to the degree of domestication, as male-biased sex ratios are common among other domestic animal species (Trut, 1996). Pups from vixens that received the tidbits also weighed more at 30 days of age, and at weaning female pups from the group which did not receive a tidbit were significantly lighter than all other pups. In an open field test at 30 days of age, the pups from vixens receiving the tidbit showed significantly higher levels of activity, with the largest differences being between female pups in the two different groups (Bakken, 1998). The author suggests that these results, along with previous ones, imply that reduced stress during pregnancy affects the vixens own reproduction as well as her female pups' future behaviour, such as increased competitive capacity, reduced infanticidal behaviour and increased number of pups weaned.

Outstanding issues that are not addressed in current scientific literature:

Does the provision of enrichment that reduces fear, handling regimes or titbit provision, and selecting for confidence have additive effects, such that if combined they could have a cumulative positive effect in silver foxes?

Are there aspects of cage structure/enrichment provision that can increase confidence in silver foxes?

References

Ahola L., Harri M., Kasanen S., Mononen J. & Pyykönen T. (2000) Effect of family housing of farmed silver foxes (*Vulpes vulpes*) in outdoor enclosures on some behavioural and physiological parameters. *Canadian Journal of Animal Science* 80:427–434.

Ahola L., Harri M., Mononen J., Pyykönen T. & Kasanen S. (2001) Welfare of farmed silver foxes (*Vulpes vulpes*) housed in sibling groups in large outdoor enclosures. *Canadian Journal of Animal Science* 81:435-440.

Akre A.K., Hovland A.L., Bakken M. & Braastad B.O. (2008) *Risk Assessment Concerning the Welfare of Animals Kept for Fur Production. A Report to the Norwegian Scientific Committee for Food Safety*. Ås NO: Norwegian University of Life Sciences.

Bakken M. (1998) The effect of an improved man-animal relationship on sex ratio in litters and on growth and behaviour in pups among farmed silver fox (*Vulpes vulpes*). *Applied Animal Behaviour Science* 56:309-317.

Bakken M., Moe R.O., Smith A.J. & Selle G.E. (1999) Effects of environmental stressors on deep body temperature and activity levels in silver fox vixens (*Vulpes vulpes*). *Applied Animal Behaviour Science* 64:141-151.

Belyaev D.K. (1979) Destabilizing selection as a factor in domestication. *Journal of Heredity* 70:301-308.

Belyaev D.K., Plyusnina I.Z. & Trut L.N. (1984/85) Domestication in the silver fox (*Vulpes fulvus* Desm): Changes in physiological boundaries of the sensitive period of primary socialization. *Applied Animal Behaviour Science* 13:359-370.

European Commission (2001) *The Welfare of Animals Kept for Fur Production –Report of the Scientific Committee on Animal Health and Animal Welfare.* Brussels BE: European Commission, Health and Consumer Protection Directorate.

Harri M., Mononen J., Ahola L., Plyusnina I. & Rekilä T. (2003) Behavioural and physiological differences between silver foxes selected and not selected for domestic behaviour. *Animal Welfare* 12:305-314.

Koistinen T., Mononen J., Hovland A.L., Korhonen H.T. & Ahola L. (2010) Good human-animal relationship. *WelFur mini reviews. 1-12: blue fox, silver fox and Finnraccoon,* pp. 109-123 [an unpublished WelFur project document].

Kristensen M.P. (1988) An evaluation of exploratory and fear-motivated behaviour as predictors of reproductive success in silver fox vixens. *Scientifur* 12:199-205.

Pedersen V. (1991) Early experience with the farm environment and effects on later behaviour in silver *Vulpes vulpes* and blue foxes *Alopex lagopus*. *Behavioural Processes* 25:163-169.

Pedersen V. (1992) Handling of silver foxes at different ages pre-weaning and post-weaning and effects on later behaviour and stress-sensitivity. *Norwegian Journal of Agricultural Sciences* 9:S529-S535.

Pedersen V. (1993) Effects of different post-weaning handling procedures on the later behaviour of silver foxes. *Applied Animal Behaviour Science* 37:239-250.

Pedersen V. (1994) Long-term effects of different handling procedures on behavioural, physiological, and production-related parameters in silver foxes. *Applied Animal Behaviour Science* 40:285-296.

Pedersen V. & Jeppesen L.L. (1990) Effects of early handling on later behaviour and stress responses in the silver fox (*Vulpes vulpes*). *Applied Animal Behaviour Science* 26:383-393.

Rekilä T., Harri M. & Ahola L. (1997) Validation of the feeding test as an index of fear in farmed blue (*Alopex lagopus*) and silver foxes (*Vulpes vulpes*). *Physiology & Behavior* 62:805-810.

Trut L.N. (1996) Sex ratio in silver foxes: effects of domestication and the *star* gene. *Theoretical and Applied Genetics* 92:109-115.

Trut L.N. (1999) Early canid domestication: the farm-fox experiment. *American Scientist* 87:160-169.

4. EUTHANASIA

HUMANE METHODS OF EUTHANASIA

Conclusions:

1. Electrocution is considered a suitable method of euthanasia for silver foxes. The current must pass first through the brain and must be applied for a minimum of 3-4 seconds.

Animals raised for fur are generally removed from their cage and immediately euthanized on farm. Although handling animals causes stress, this can be minimized by euthanizing animals at or near their home cage, which is likely in the vicinity of other foxes (American Veterinary Medical Association [AVMA], 2007). According to Norwegian regulation, euthanasia should be completed out of sight of other animals, which makes some transport necessary (Norway, 2011). The criterion for choice of method of euthanasia must be a rapid loss of consciousness with minimal discomfort to the animal (AVMA, 2007; Canadian Council on Animal Care [CCAC], 2010). Unconsciousness is essential because it indicates that the cerebral cortex is non-functional and therefore painful effects cannot be experienced (AVMA, 2007). Farmed foxes can be euthanized by electrocution, with a projectile penetrating the brain, with carbon monoxide, and with lethal injection (Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes [European Convention], 1999; European Convention, 1999; Council of the European Union, 2009; Koistinen et al., 2010).

Euthanasia by electrocution: Electrocution using oral and rectal electrodes is routinely practiced as a method of stunning and euthanizing farmed foxes as a single process. As animals must be unconscious before being killed by electrocution, electric stunning can be done by first passing the electric current through the brain in order to induce a loss of consciousness before electricity is passed through the rest of the body to kill the animal (AVMA, 2007). Effective electrical stunning is signified by extension of the limbs, opisthotonos, downward rotation of the eyeballs and tonic spasm changing to clonic spasm, followed by muscle flaccidity (AVMA, 2007). After the animal is stunned, an electric current must be passed through the body of the animal to cause the heart to fibrillate. This leads to multiple organ failure and death as the fibrillating heart is unable to provide the necessary blood flow to the brain. A current of 0.31±0.01 amps and 111.2±18.7 volts applied for 3 to 4 seconds resulted in a complete heart fibrillation in foxes (Lambooy, 1984). Two of 12 foxes that had a current of 0.40±0.11 amps and 110.0±7.9 volts applied for only 1.1±0.3 seconds had incomplete heart fibrillation and recovered from the electrocution (Lambooy, 1984). As the stunning and euthanasia process is very quick, stunning and euthanasia by electrocution are generally done concurrently using the same apparatus.

Electrocution as a method of euthanizing foxes was also examined by Korhonen et al. (2009). Electrocution was performed using the "Fox Final^{TM}" apparatus (a commercially available product from Finland) which uses rectal and oral electrodes. After stunning with a current of 0.32 to 0.69 amps for 2.34 to 5.21 seconds, all animals appeared to be unconscious. The palpebral and corneal reflexes were absent in 12 of 15 foxes, while in three foxes the corneal reflex was present for about 10 seconds after stunning. Most foxes had low amplitude muscle tremor in the face and limb muscles for 1-3 minutes after stunning. These movements corresponded well with the brain activity on the electroencephalography (EEG) and most likely

reflect the epileptic activity of the motor cortex of the foxes. No pulse was found and breathing ceased after stunning. A cardiac fibrillation pattern was seen beginning after stunning which gradually declined over 17-20 minutes, ending with an isoelectric (flat) line. The electrocardiography (ECG) pattern did not return to normal in any cases. The electroencephalogram also did not recognise any brain activity after 60-120 seconds post-stunning. Brainstem auditory evoked responses (BAER) were also examined, and tended to be present immediately after stunning, but then declined and disappeared between 0.5 and 4.3 minutes after stunning. Post-mortem examinations revealed generally mild changes. The authors concluded that electric stunning of foxes under proper conditions brings about an immediate and irreversible state of unconsciousness in the animal and as such is efficient and humane as a method of euthanasia for farmed foxes.

Electrocution as a method of euthanasia requires specialized equipment and skills to ensure adequate current passage through the brain to induce loss of consciousness and cardiac fibrillation as a one or two step procedure (AVMA, 2007). Electric current applied from head to tail, head to foot or head to moistened metal plates that animal is standing on are unacceptable as the animal may be conscious for a period of time before death (AVMA, 2007).

Confirmation of death: The death of each animal must be confirmed, generally through the cessation of vital signs. Death has been defined as the moment the fox no longer had any motor activity, was not breathing, heart sounds could not be auscultated and palpebral, corneal and flexor reflexes were absent (Korhonen, 2010). At this point no normal heart or brain activity can be recorded by ECG, EEG and BAER.

References

American Veterinary Medical Association (AVMA) (2007) AVMA guidelines on euthanasia (formerly Report of the AVMA panel on euthanasia). Available at http://www.avma.org/issues/animal_welfare/euthanasia.pdf.

Canadian Council on Animal Care (CCAC) (2010) *CCAC guidelines on: euthanasia of animals used in science*. Ottawa ON: Canadian Council on Animal Care..

Council of the European Union (2009) Council regulation on the protection of animals at the time of killing. Council Regulation (EC) 1099/2009. *Official Journal of the European Commission* L303:1–30. Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:303:0001:0030:EN:PDF

Koistinen,T., Lindeberg H., Hovland A.L., Korhonen H.T., Ahola L. & Mononen J. (2010) Absence of pain induced by management procedures. *WelFur Mini-reviews 1-12: blue fox, silver fox and Finnraccoon,* pp. 68-77 [an unpublished WelFur project document].

Korhonen H.T. (2010) Killing farmed mink with CO and CO_2 [abstract]. *NJF-Seminar No. 440.* Oslo, NO, September 29-October 1, 2010. *Scientifur* 34: 57.

Korhonen H.T., Cizinauskas S. & Viitmaa R. (2009) Evaluation of the traditional way of euthanasia of farmed foxes from an animal welfare point of view. *Annals of Animal Science* 9:73-87.

Lambooy E. (1984) Electrocution of foxes; an ethically acceptable method? [Abstract]. *Tijdschr Diergeneeskd* 109:460-464.

Norway (2011) Lovdata: FOR 2011-03-17 nr 296: Forskrift om hold av pelsdyr (OR 2011-03-117 No. 296: Regulations relating to the keeping of fur, in Norwegian). NO: Landbruks- og matdepartementet.

Standing Committee of the European Convention for the Protection of Animals kept for Farming Purposes (T-AP) (European Convention) (1999) *Recommendations concerning fur animals*. Strasbourg FR: Council of Europe. Available at http://www.efba.eu/download/1_recommendation_concerning_fur_animals.pdf