THE WELFARE OF FARMED MINK (*MUSTELA VISON*) IN RELATION TO BEHAVIOURAL SELECTION: A REVIEW

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Abstract *Animal Welfare 2001, **10:** 41-52*

Animal welfare is a major issue in Europe, and the production of mink, Mustela vison, *has also been under debate. One common method of solving animal welfare problems is to adapt the environment to fit the behavioural needs of the animals. In comparison with other forms of husbandry, the mink production environment has remained relatively unchanged over the years and provides for some of the most obvious needs of mink. Whether today's typical housing conditions adequately meet the welfare requirements of mink is currently a topic of discussion. An alternative approach to improving welfare is to modify the animals so that they are better adapted to farming conditions. In large-scale animal production, handling of the individual can be a sporadic event, making an animal's inherent characteristics for temperament and adaptability important factors to consider with respect to its resultant welfare.*

In this review we present and discuss experiments on behavioural selection for temperament, and against undesirable behaviours, such as fur chewing, in mink. Fur chewing behaviour can be reduced by selection, apparently without any negative effects, whereas only a little is known about the nature and consequences of selecting against stereotypic behaviours. Long-term selection experiments have shown that it is possible to reduce fearfulness in farmed mink. Using a relatively simple test, it is possible for farmers to add behavioural measurements to their normal selection criteria and thereby improve the welfare of farmed mink.

Keywords: *animal welfare, domestication, fear, fur chewing, mink, temperament*

Introduction

During the last 80 years of mink breeding in Denmark, traits related to welfare have not been systematically considered in breeding programmes, although very poorly adapted individuals with deviant, unwanted behaviours have probably been excluded from the stock by farmers.

On an experimental basis, however, controlled selection of mink, *Mustela vison*, for temperament has been conducted since 1988 at the Danish Institute of Agricultural Sciences (DIAS), with the aim of enhancing and investigating the ongoing process of domestication, by means of practical behavioural tests.

In their review on the welfare of farmed mink, Nimon and Broom (1999) suggested that no positive effects with regard to temperament and adaptation could be achieved as a result of selection in farmed mink. We disagree, and this review presents results based on experiments performed over the last decade which illustrate that selection is of importance and can contribute to the welfare of production animals, such as farmed mink.

Selection in domestic animals

Domestic production animals are often selected for traits related to production economy, such as growth rate in relation to feed intake. Selection for a specific trait may result in detrimental changes to the animal. Examples are known from several species of livestock, and include the leg problems in pigs and chickens which are an adverse effect of intense selection for growth rate, meat percentage and feed efficiency (Jørgensen & Vestergaard 1990; Sørensen 1992). Certain breeds of mink, selected mainly for fur characteristics, have an increased incidence of physical defects (eg bleeder tendencies and susceptibility to infection in types carrying a recessive Aleutian gene [Nes *et al* 1988]; another example is the white 'Hedlund' mink whose ability to hear degenerates [Flottorp & Foss 1979], and whose caring ability for kits may thereby be reduced).

If animals are selected for traits in one specific production system, a major alteration of the system may make the animals appear less adapted. One example is the change in nesting behaviour of laying hens selected in battery cage production (Kjær 1995), whose ability to adapt to new production systems with outdoor areas may be reduced when they have to search for nests. In contrast, the cage system for mink has – at least in Denmark – remained relatively unchanged over the years in large-scale production, and so far no notable welfare improvements have been achieved with new designs compared to the existing ones (eg Hansen [1988; 1990]; Hansen *et al* [1994]). However, experiments using operant conditioning techniques (Cooper & Mason 2000; Hansen *et al* 2000) may contribute to an understanding of how mink prioritize resources in a cage system.

Besides common production traits, several studies have indicated that it should be possible to select directly for different types of behaviour. One example is feather pecking in laying hens, where the heritability (h^2)[1] of this behaviour was found to be up to 0.38, and so could form the basis for selection programmes against this trait which would increase the welfare of the animals (Kjaer & Sørensen 1997). A subject of particular interest in farm animal research has been genetic influences on fear and reactions towards humans (for a review, see Grandin [1998]). A number of results are available for agricultural species such as sheep (Roumeyer & Bouissou 1992; Le Neindre *et al* 1993), cattle (Dickson *et al* 1970; Le Neindre *et al* 1995), pigs (Hemsworth *et al* 1990), and poultry (Craig *et al* 1983; Jones 1986; Craig & Muir 1989). In a study of domestic cats, h^2 was estimated as between 0.25 to 0.31 for contact and fear towards unfamiliar humans (Braastad *et al* 1999), but these heritabilities were based upon questionnaires. Heritabilities based on behavioural observations have been described in dogs for fear ($h^2 = 0.46$; Goddard & Beilharz [1982]) and nervousness ($h^2 = 0.58$; Goddard &

[1] The proportion of total variation that is due to additive genetic effects.

Beilharz [1983]). In mink, a heritability of 0.38 for approaching humans has been found (Hansen 1993).

Genetic background of behaviour and welfare-related traits in mink

In fur production, research into the genetic background of behaviours that are thought to be linked to welfare has focused on two areas: i) specific undesirable behaviours; and ii) temperament in a broad sense.

Undesirable behaviours: stereotypy and fur chewing

Behaviours which are linked to reduced welfare or impair production are undesirable in farmed mink. Examples of these types of behaviours are apathy, hyperactivity, stereotypy, infanticide, and fur chewing.

Stereotypic behaviour has been regarded as indicative of reduced welfare (Duncan *et al* 1993), but the actual significance of this behaviour for the welfare of animals, including mink, may not always be obvious (Mason 1991; 1992; 1993; Hansen 1999). The frequency of stereotypies is dependent on the environment and management, while the tendency to perform stereotypic behaviour is assumed to have a hereditary component in mink (Zanella & Mason 1998; Tauchi *et al* 1999). However, the published evidence for changes in stereotypic behaviour through selection is limited (De Jonge 1992). One study found no significant correlations between the stereotypies of the mothers and those of the kits, and concluded instead that litter size may be involved in determining the later stereotypy level of young mink (Hansen 1993).

Another type of unwanted behaviour seen in mink is the chewing/sucking of their own or another's fur, resulting in the destruction of hairs. Unlike typical biting, this behaviour does not perforate the skin, and is not correlated with aggression (Damgaard & Hansen 1996; Malmkvist & Hansen 1997). Therefore, we consider that fur chewing is a better term than 'self-mutilation', as used in the theoretical review of Nimon & Broom (1999), to describe this behaviour. Furthermore, fur chewing is not always self-directed, but can be performed on another mink (Hansen *et al* 1998). Hypotheses have linked certain types of fur chewing to under-stimulation, or lack of natural stimulation, due to its diurnal rhythm and pattern of occurrence during the production season (Malmkvist & Hansen 1997; Hansen *et al* 1998). Fur chewing of the tail probably does not exist in free-living mink (Dunstone 1993).

The overall tendency to perform fur chewing has a hereditary component, as illustrated by Danish selection experiments (Nielsen 1996), in which h^2 for fur chewing was estimated to 0.3 (Nielsen & Therkildsen 1995). Two lines were created in which breeding animals were selected for/against neck chewing on their cage mates. After a few generations, clear differences between the mink lines with regard to neck, body and tail chewing were evident (Figure 1). Although the selection was based on neck chewing, the subsequent generations in the fur chewing line showed a clearly increased tendency for body chewing. In an earlier study, De Jonge (1988) also found that genetic factors play a possible role in tail chewing.

It has been nearly, but not completely, possible to eradicate this deviant and unwanted behaviour by selection. At the same time, several studies have shown that management (eg age at weaning and housing conditions) and season (eg the influence of male sexual maturity on neck grip and other seasonal behavioural activities of higher priority, such as female kit care) determine the occurrence of fur chewing in a population (De Jonge 1988; Mason 1994; Hansen *et al* 1998). Malmkvist and Hansen (1997) found that there was no significant difference between mink from low (n =12) and high (n =12) chewing lines – either in the time budgets for other kinds of behaviour or in physiological reactions (eg cell populations in blood) to repeated handling stress. In practice, selection against fur chewing is included in the Danish mink breeding programmes, for reasons of economics.

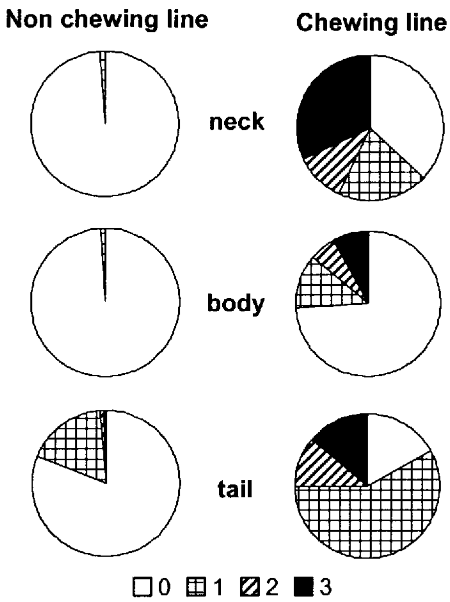

Figure 1 **Fur chewing in the F_4 generation of mink, selected for or against neck chewing. Chewing classes: 0 – no chewing; 1 – hair removed over minor areas of the neck and body (< 2cm diameter) and ≤ 1cm of tail tip; 2 – hair removed over larger areas of the neck and body and up to 1/3 of tail tip; 3 – widespread areas of damage and over 1/3 of tail tip without hair. (Minor tail chews/sucks [score 1] are often undetectable on the fur after pelting.) Data from Malmkvist and Berg (1997).**

Temperament

Research on silver foxes, *Vulpes vulpes*, (Belyaev & Trut 1987) and mink (Trapezov 1987; Hansen 1996) has shown that it is possible to select for hereditary behaviour towards humans. The aim of selecting these fur animals for temperament has been to improve their welfare. In addition, correlations between temperament and reproduction have been documented in several domestic species: for instance, selection for tameness in silver foxes has led to a number of behavioural, physiological and morphological changes as well as to higher fertility (Naumenko & Belyaev 1980; Kolsnikova *et al* 1985; Osadchuk 1992). Studies on pigs have shown a negative correlation between the level of fear towards humans and the reproductive performance of sows (Hemsworth *et al* 1990; Hemsworth & Coleman 1996). Besides its economic importance, poor reproduction has been used as an indicator of reduced welfare in certain production systems (Moberg 1985; Bakken *et al* 1994). Fearful or aggressive animals may be more difficult to handle, and the keeping of these can conflict with ethical concepts in our society. The Danish *Animal Protection Act*, for example, states that 'Animals should be treated well and should be protected in the best possible way against pain, suffering, fear, permanent injury and substantial inconvenience' (Danish Ministry of Justice 1991).

Since 1988, controlled selection of breeding mink, based on their behaviour towards humans, has been practised at the Danish Institute of Agricultural Sciences (DIAS). This selection for temperament in mink continues, and two breeding lines of mink exist today, showing consistent differences in their approach/avoidance towards humans, in comparison with an unselected control line (Figure 2). The selection of breeding animals is based on two tests: i) the stick test (Figure 3), and ii) Trapezov's hand test (Figure 4), in which approach and avoidance are interpreted as reflecting the fear level of the animal (Gray 1987).

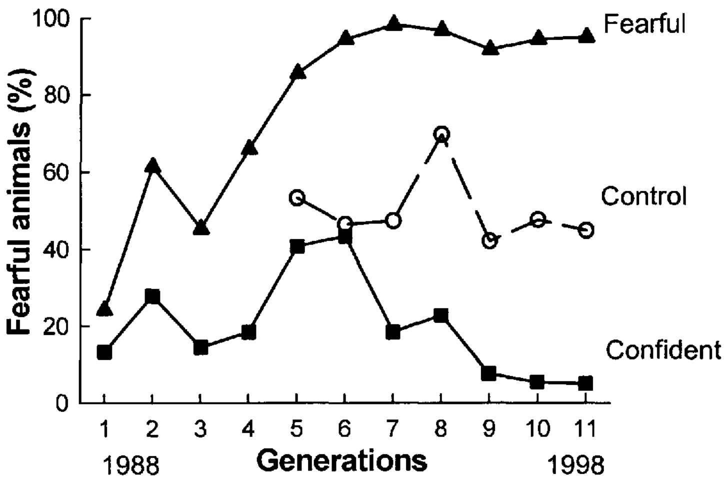

Figure 2 **Proportion of mink reacting fearfully (ie showing avoidance in the stick test) in a selection experiment over 11 generations. Animals (n = c 8700) were the offspring from two breeding lines of mink selected for fearful or confident reactions towards humans, and from one unselected control line (included in 1992).**

In the stick test, the animal's reaction towards a human putting a tongue spatula through the cage mesh is scored. Reactions are classified into four exclusive categories: 1 – explorative, the mink sniffs the stick persistently; 2 – fearful, the mink escapes, and does not contact the stick; 3 – aggressive, the mink attacks and delivers hard bites to the stick; and, 4 – uncertain, the tested mink shows a mixture of responses and cannot be placed in one of the other three categories with certainty. (Figures 2 and 5, only present data for mink showing explorative or fearful responses, because these are the predominant ones.) In Trapezov's hand test (inspired by Trapezov [1987]), the behaviour of the mink is scored according to its reaction during human intrusion into the cage and attempts at handling. Eleven distinct classes are used to categorize the responses of the mink. (For a full description of both tests see Malmkvist [1996].)

At DIAS, both tests are conducted in the mink's home cage, and the test scores obtained each year are used as the basis for choosing the proportion of animals to become next years' breeders.

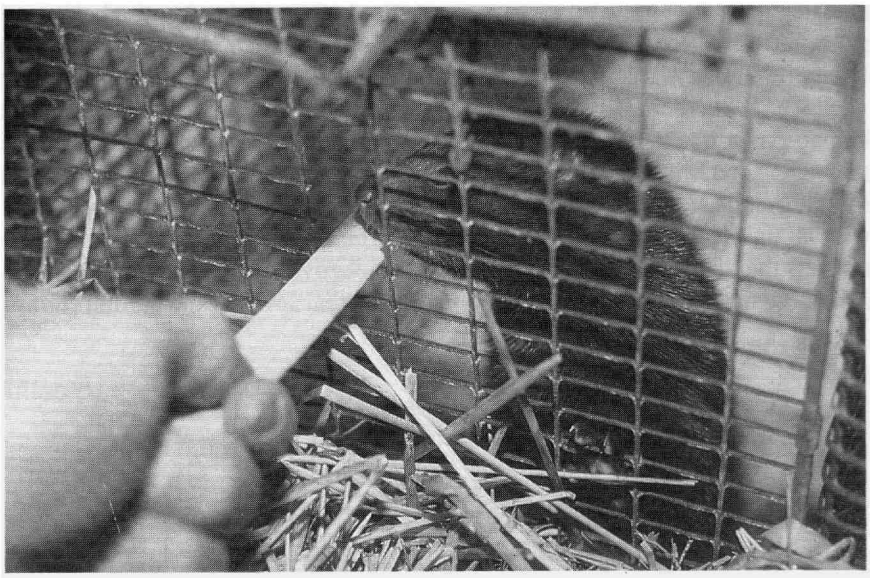

Figure 3 **Mink interacting with a spatula in the stick test, one of the tests upon which selection at DIAS has been based since 1988.**

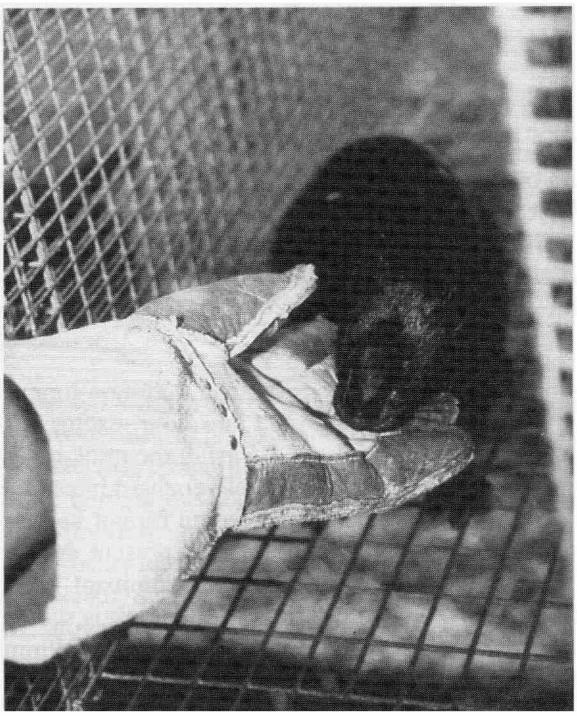

Figure 4 **Young mink from the confident breeding line interacting with a human in Trapezov's hand test.**

All lines (fearful, confident and control) in Figure 2 originated from the same group of 'Scanblack' mink in 1988. Approximately 70 females and 25 males are used as breeding animals within each line, producing approximately 275–325 kits in each line per year. These are born in May, kept under identical conditions, and tested in September–December. (Note that only yearlings are used as breeding animals in this selection experiment; thus, there is no overlap between generations.)

To investigate the relative importance of hereditary and environmental factors on mink temperament, we performed a cross-fostering experiment in the birth season of May 1990. Kits (n = 82), descended from females selected for confident behaviour, were interchanged with kits (n = 78) originating from females selected for fearful behaviour 1–2 days after birth. Kits (n = 106) remaining with their confident mothers and kits (n = 164) remaining with their fearful mothers were used as controls. All animals were otherwise kept and tested under identical farm conditions. The reaction of the kits towards humans in the stick test was evaluated monthly after weaning in July–November 1990.

From the results of this experiment (Figure 5), we conclude that the temperament of kits is dependent on their biological origin, rather than on the behaviour of their foster mother. Offspring from fearful mink gradually habituated to human contact and in November (the last testing time), they reacted no differently than offspring from the confident line in the stick test. Habituation will occur over time as the minks' fear of humans is gradually reduced by repeated exposure, and even wild animals can eventually habituate to humans. However, in large-scale animal production, where handling of an individual is a sporadic event, and does not take place systematically, an inherent characteristic for low fearfulness (ie a high general threshold level for experiencing fear) and a high ability to adapt, would seem to be important with respect to the animals' resultant welfare.

It is important to understand to what extent the reaction towards humans can be generalized to other fear-eliciting situations in order to estimate the full consequences of selection on the welfare of mink. Previous studies have shown that not only is the reaction of these mink lines towards humans different, but so is their reaction towards a new object (Hansen 1997; Malmkvist & Hansen 1999), and towards an unknown intruder mink placed in the home cage (Hansen 1997).

Besides data on behaviour, physiological recordings and production data from mink lines of different temperament have also been collected at DIAS. Eight years of selection for a confident reaction towards humans has affected willingness to mate, so that the group of confident mink can be mated earlier than groups of fearful or non-selected animals (Malmkvist *et al* 1997). Mink from the fearful line show higher plasma cortisol levels after handling when compared with mink from the confident line, even though the capacity of the adrenals to secrete cortisol (as evaluated in an ACTH-challenge test) has not been affected by selection (Hansen 1997). The selection appears to have affected the minks' perception of environmental stimuli, rather than just their ability to express fear reactions. New studies have shown that marked differences exist between these genetic lines in their sensitivity towards an anxiolytic drug, so that lower doses are needed to reduce fear (eg to increase approaches towards humans and objects) in mink from the confident line than in mink from the fearful line (Malmkvist & Hansen 1999). A smaller study also found measurable differences in stress-induced hyperthermic responses between mink selected for confident and fearful behaviour (Korhonen *et al* 2000).

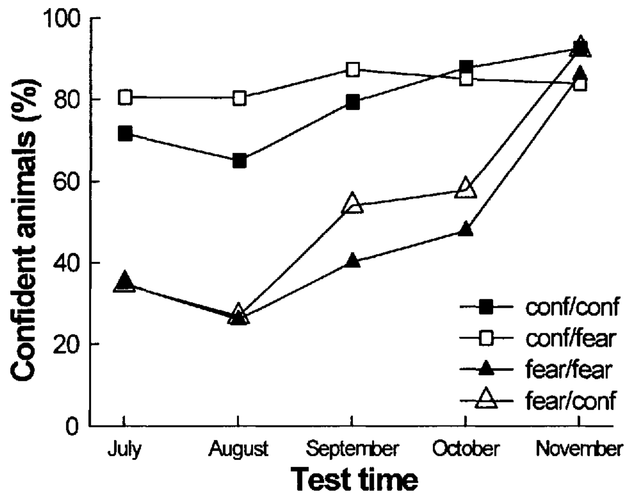

Figure 5 **Proportion of post-weaning mink reacting confidently (ie approaching humans in the stick test) following cross-fostering experiments on day 1–2 after birth. Conf/conf – kit stayed with mother from confident line (n = 106); conf/fear – kit from confident line transferred to mother from fearful line (n = 82); fear/fear – kit from fearful line stayed with mother from fearful line (n = 164); fear/conf – kit from fearful line transferred to mother from confident line (n = 78).**

Surveys on Danish farms show that there is a range of variation in the fear levels of mink, as measured by the stick test. An early study found significant differences between farms, with, on average, the same proportion of animals reacting confidently (45.5%) and fearfully (47.9%). (This was a test of 1128 females on 22 farms; 6.6% of the animals did not clearly fall into these two categories [Hansen & Møller 1988].) A survey of six farms in 1999, performed at the same time of the year with a total of 1768 females, found 61.9 per cent of the animals were consistently classed as confident towards humans in the stick test, and 23.0 per cent of the animals as fearful (Hansen & Møller in press). This may indicate that farmers pay increased attention to improving welfare and production results by having less fearful mink in the breeding stock.

Conclusions and animal welfare implications

Experiments have shown that selective breeding for temperament in mink can lead to reduced fearfulness. Based on this experimental data in combination with findings from actual farm populations, we conclude that the use of an appropriate breeding programme, including selection for temperament, can be a way of further reducing the number of fearful mink on farms. Although selection can be an efficient tool for improving welfare, we also recommend continued research into developing better production environments, and teaching farmers more appropriate management routines.

One important factor in improving the welfare of farmed mink is to ensure the dissemination of knowledge, based upon stringent scientific research on the subject, to farmers and advisors.

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