Applied Animal Behaviour Science 158 (2014) 76–85

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Bite marks in mink—Induced experimentally and as reflection of aggressive encounters between mink

Steffen W. Hansen*, Steen H. Møller, Birthe M. Damgaard

Department of Animal Science, Aarhus University, Blichers Allé 20, Post Box 50, DK-8830 Tjele, Denmark

ARTICLE INFO

Article history:
Accepted 13 June 2014
Available online 21 June 2014

Keywords:
Welfare indicator
Group housing
Aggression
Mink

ABSTRACT

For many years, bite marks have been used as an indicator for aggression in mink production systems. However, the validity of bite marks as indicator of aggression has recently been questioned. We therefore tested the following hypotheses: (1) experimentally applied pressure to, or penetration of, the pelt during the growth phase of the winter coat will produce marks that can be recognized as bite marks at pelting, (2) bite marks applied experimentally by use of an artificial tooth or occurring due to social/aggressive interactions (bites) between mink are only visible if pressure/bite on the mink skin is applied during the active growth phase of the winter coat prior to time when matured, (3) bite marks will be easier to detect on dark mink than on mink with light coloured fur and (4) the number of bite marks accumulates and increases with time mink are housed in groups. The experimental mink were of the brown colour type ($N = 140$) and the white colour type ($N = 60$). Twenty brown and 20 white mink (housed in pairs since weaning) were housed individually at the age of 16 weeks. Every second week (at the age of 20, 22, 24, 25 and 28 weeks), four brown and four white mink were subjected to pressure by an artificial tooth. Before pressure was applied, each mink was anaesthetized and pain treated.

In order to investigate when bite marks from cage mates are inflicted and to what extend they accumulate over time, 120 brown and 40 white juvenile mink were placed in groups of four in climbing cages after weaning. Every second week (at the age of 20, 22, 24, 26 and 28 weeks) group housed mink were moved to single housing in standard cages in order to prevent further bites from cage mates.

At the age of 29 weeks, all mink were killed individually by CO_2 and the pelts were examined for bite marks.

The results showed that: (1) experimentally applied pressure on the skin can be recognized as bite marks in brown mink at pelting, (2) bite marks are easier to detect on brown mink than on white coloured mink ($P < 0.001$), (3) bite marks applied experimentally by use of an artificial tooth or occurring due to social/aggressive interactions (bites) between mink are only visible if pressure/bite on the mink skin is applied during the active growth phase of the winter coat prior to time when matured, and (4) the longer time mink are kept in groups, the more bite marks can be observed on the skin ($P < 0.001$).

The study has shown that bite marks are a valid and useful welfare indicator for quantifying the social tolerance of dark mink and consequently the risk for serious bite wounds.

* Corresponding author. Tel.: +45 87157942.
E-mail address: Steffenw.hansen@agrsci.dk (S.W. Hansen).

http://dx.doi.org/10.1016/j.applanim.2014.06.008
0168-1591/

1. Introduction

Group housing was approved by the European Convention, 1999 for perceived welfare reasons (CoE, 1999) and included in the Danish legislation in 2006. Since then, group housing of mink has become increasingly common because it increases the stocking density and thereby is more economic.

Group housing is, however, in conflict with the solitary and territorial lifestyle of mink, where the male territory may overlap that of several females in the wild (Dunstone, 1993). Therefore, adult mink have been housed singly and juveniles (less than 7 months) have in general been housed in male + female pairs, since the American mink (*Neovison vison*) was introduced in Scandinavia in the 1920s. The social tolerance between sexes still seems to be greater than within sex in group housed mink (Berg and Møller, 2010; Alemu et al., 2014). Therefore, group housing can be defined as housing more than one mink of the same sex in the same cage.

Aggression increases with the age of the kits which causes dispersal of the litter and establishment of individual territories (Dunstone, 1993). Mink has a strict annual production cycle entrained by the gradual shifts in day length and especially the vernal and autumn equinox. Decreasing day length initiates the growth and maturation of a heavy dense winter coat beginning around the autumn equinox and ends early November (Basset and Llewellyn, 1949; Blomstedt, 1989). The autumn equinox also seems to be the latest time of dispersal of juveniles (Dunstone, 1993). It can therefore be expected that the number of bite marks, wounds and other signs of aggression increase in group housed mink after the autumn equinox. This also seems to be the case in practice, based on mortality rate and treatment records, although no data on this seems to have been published yet.

For many years, bite marks have been used as an indicator of aggression in mink production systems (Pesso, 1968; Hansen and Damgaard, 1991; Damgaard and Hansen, 1996; Hansen et al., 1997; Mononen et al., 2000; Pedersen and Jeppesen, 2001; Hansen and Houbak, 2005; Hänninen et al., 2008a,b; Hansen and Jeppesen, 2008; Berg and Møller, 2010; Hansen and Møller, 2012). Bite marks, defined as dark spots on the leather side of the matured mink pelt has been used for a number of reasons: (1) bite marks are almost never seen in singly housed mink (Damgaard and Hansen, 1996; Pedersen and Jeppesen, 2001) and less frequent in pairwise than in group housed mink (Hansen and Damgaard, 1991), (2) bite marks correlate to the level of aggression and wounds observed (Hansen and Møller, 2012) and (3) bite marks are often seen in high numbers at the base of the tail (Photo 1) where severe bite wounds are also most frequent (Møller and Hansen, 2014 (Personal communication/results under publication)). Therefore, despite the widespread use of bite marks as indicator of aggression, it has neither been tested if bite marks can actually be caused by a bite from a cage mate, nor under which conditions bite marks develop.

The validity of bite marks as indicators of aggression has recently been questioned by van Willingen et al. (2012), based on a lack of scar tissue or other traces of penetration of the skin in connection with the bite mark. Based on this, it was suggested that bite marks should instead be called blue spots, and that they could be caused by a spot-wise delay of maturation of hair follicles, in the priming of the winter coat. However, no support for a hypothesis of spot-wise delay of maturation of hair follicles was presented and no other causing agent for such a delay than bites was suggested. Nevertheless, the paper accentuated the need for a clarification of the causing agent of bite marks, especially in relation to the use of bite marks as an indicator of aggression.

Bite marks cannot be seen on the fur side of the pelt but as dark (black, brown or grey) spots on the bright leather side (inside) of the matured mink pelt. Bite marks can be recorded at pelting, after fleshing, when the leather side of the pelt has been scrapped for fat and subcutaneous tissue because the dark spots are in contrast to the bright leather side of the skin. The colours of bite marks do have some similarity with immature pelts, as suggested by van Willingen et al. (2012), although immature pelts involve either the neck area or the whole pelt and do not occur in spots.

As bite marks are typically observed in dark mink, it is reasonable to assume that bite marks are accumulations of the dark melanin grains in dark coloured mink. Such accumulations of melanin grains in the dermis might be the result of destruction of the hair follicles in the active (anagen) growth phases of the winter coat hairs. This could cause (the follicles to burst and) melanin granules (colour pigments) to be implanted in the dermis like a tattoo. Melanin grains could also be visible due to a spot-wise stop or delay of maturation of hair follicles, in which the winter coat does not prime before pelting. In any case, the only cause of visible melanin grains in otherwise prime/mature pelts that is consistent with the present knowledge seems to be bites applying a pressure high enough to cause the hair follicles to burst or stop priming.

A crucial point in such a clarification is if the physical pressure of a mink bite can cause a bite-mark. Therefore, a link between the pressure of an aggressive bite and a bite mark must be examined experimentally.

Our first hypothesis was to test whether experimentally applied pressure to, or penetration of, the pelt during the growth phase of the winter coat will produce marks that can be recognized as bite marks at pelting. Two sub-hypotheses follow from this. Hypothesis (2) Bite marks are only visible if pressure is applied during the active growth phase of the winter coat prior to maturation of the fur and hypothesis (3) Bite marks will be easier to detect on dark mink than on mink with light coloured fur. The objective, therefore, was to test if, and at what stages of the active growth phase of the winter coat it is possible to produce experimental bite marks in dark and light coloured mink pelts by applying pressure with artificial teeth.

Furthermore, we wanted to examine whether the number of bite marks actually accumulated and increased with time in group housing in the susceptible period between the autumn equinox and pelting. We therefore also tested the fourth hypothesis that the longer time into the growth phase of the winter coat mink are kept in groups, the more injuries and bite marks can be observed in the mink.